

SEPTEMBER 1973 60 CENTS

Popular Science

THE **What's New** MAGAZINE

**EPA/CHRYSLER
TURBINE CAR**
Will It Win
the Fuel-Saving
"Clean-Engine"
Sweepstakes?

The Facts Behind
**THE HASSLE OVER
ATOMIC-ENERGY SAFETY**

From U.S. Patent Office
... A New Program to
**PROTECT YOUR
INVENTION**

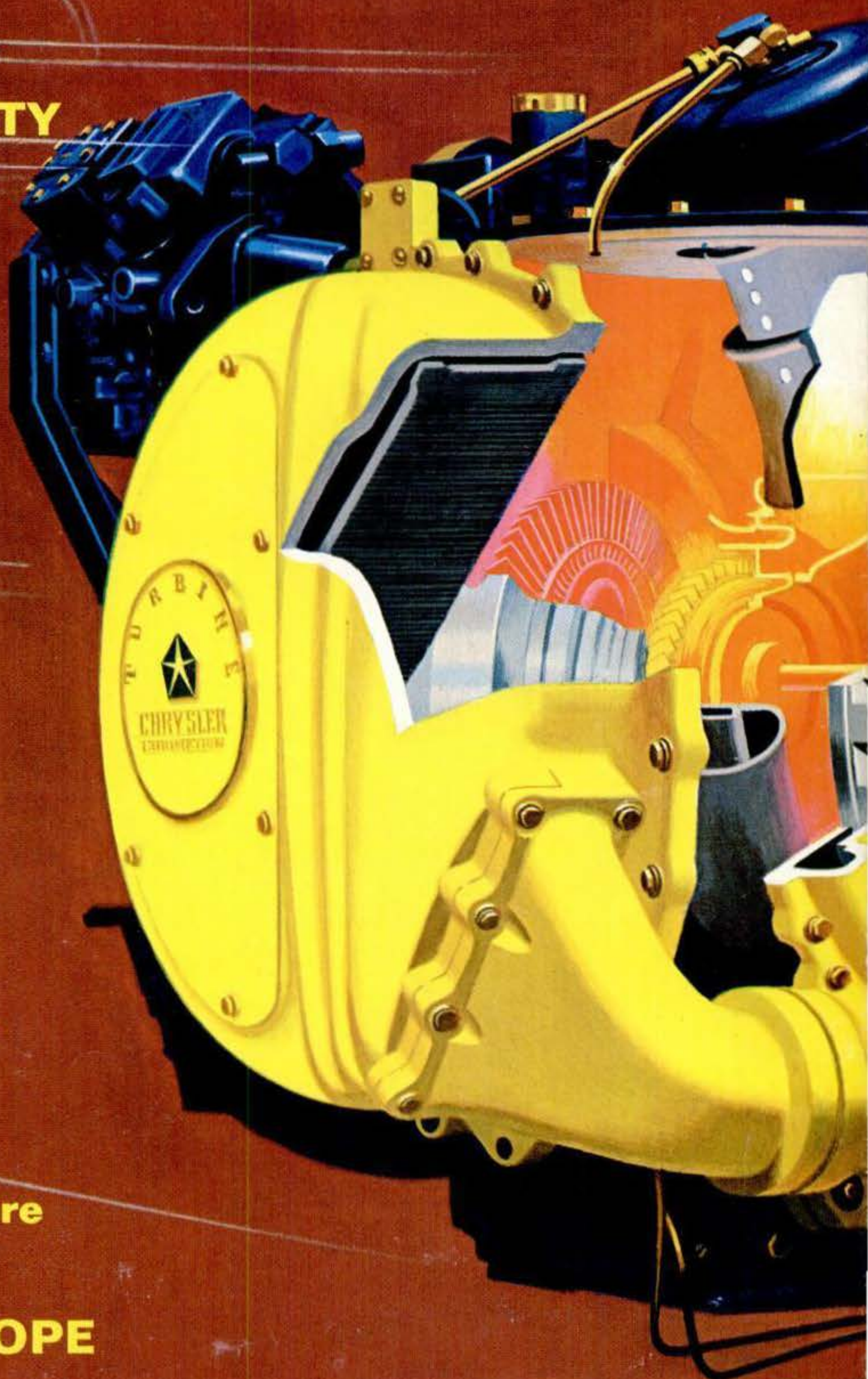
TORNADOES
Science Tracks Down
the Dread Twister

Troubleshooting Your
Car's Starting System

20 Pages of Great Ideas to
IMPROVE YOUR HOME
"Wide-Open-Spaces"
Bedroom in Your Attic
Artificial Stone and
Brick — Better Than Real?
Two Rooms Out of One
Soil Cement: "Dirt-Cheap"
Surface for Driveways,
Walks, Patios
Two Ways to No-Space
Kitchen Storage... and More

Test Report on Four
COMPACTS FROM EUROPE
Big-Car Prices, but
Small-Car Fuel Economy

...plus 33 other articles and features

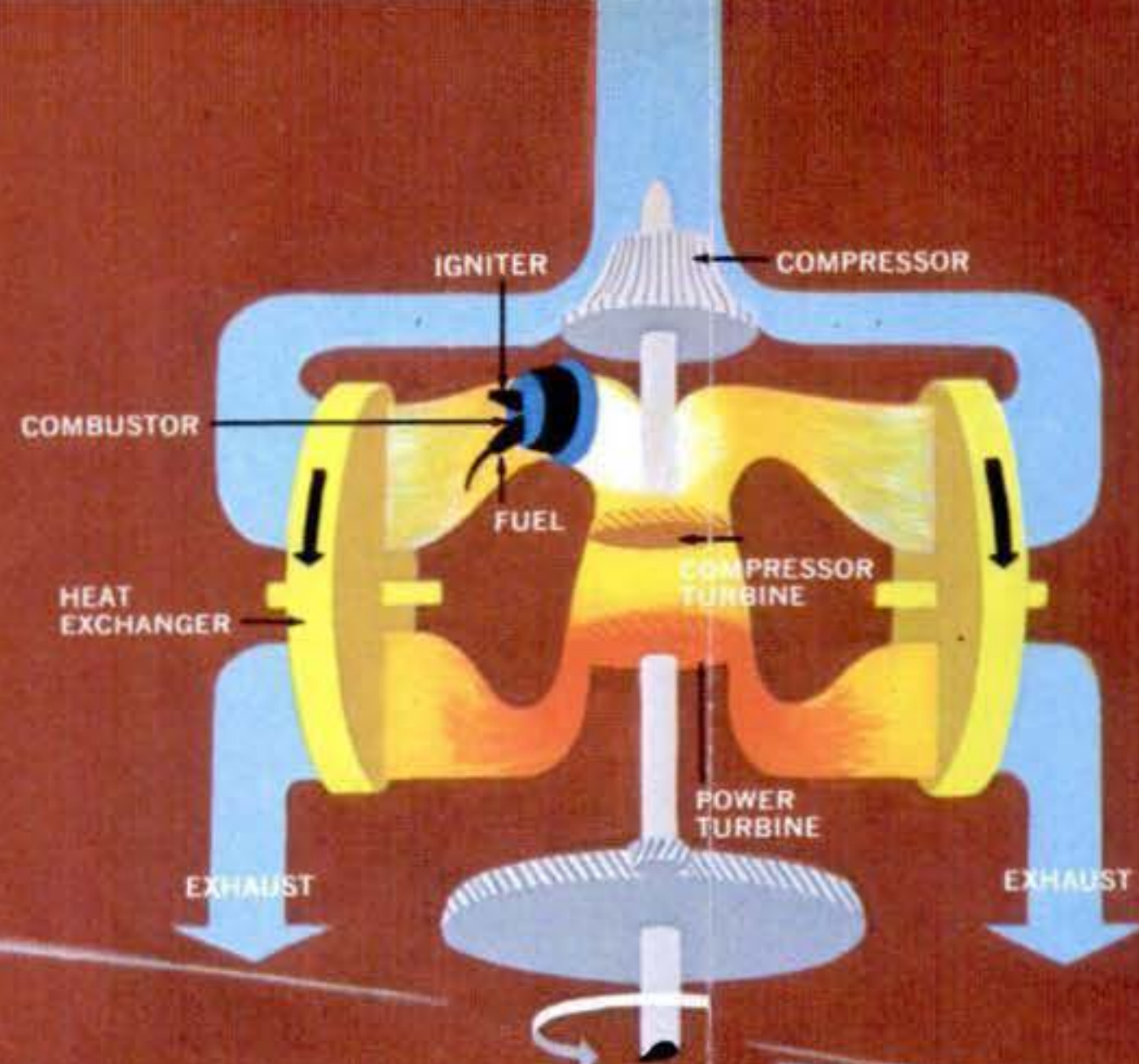


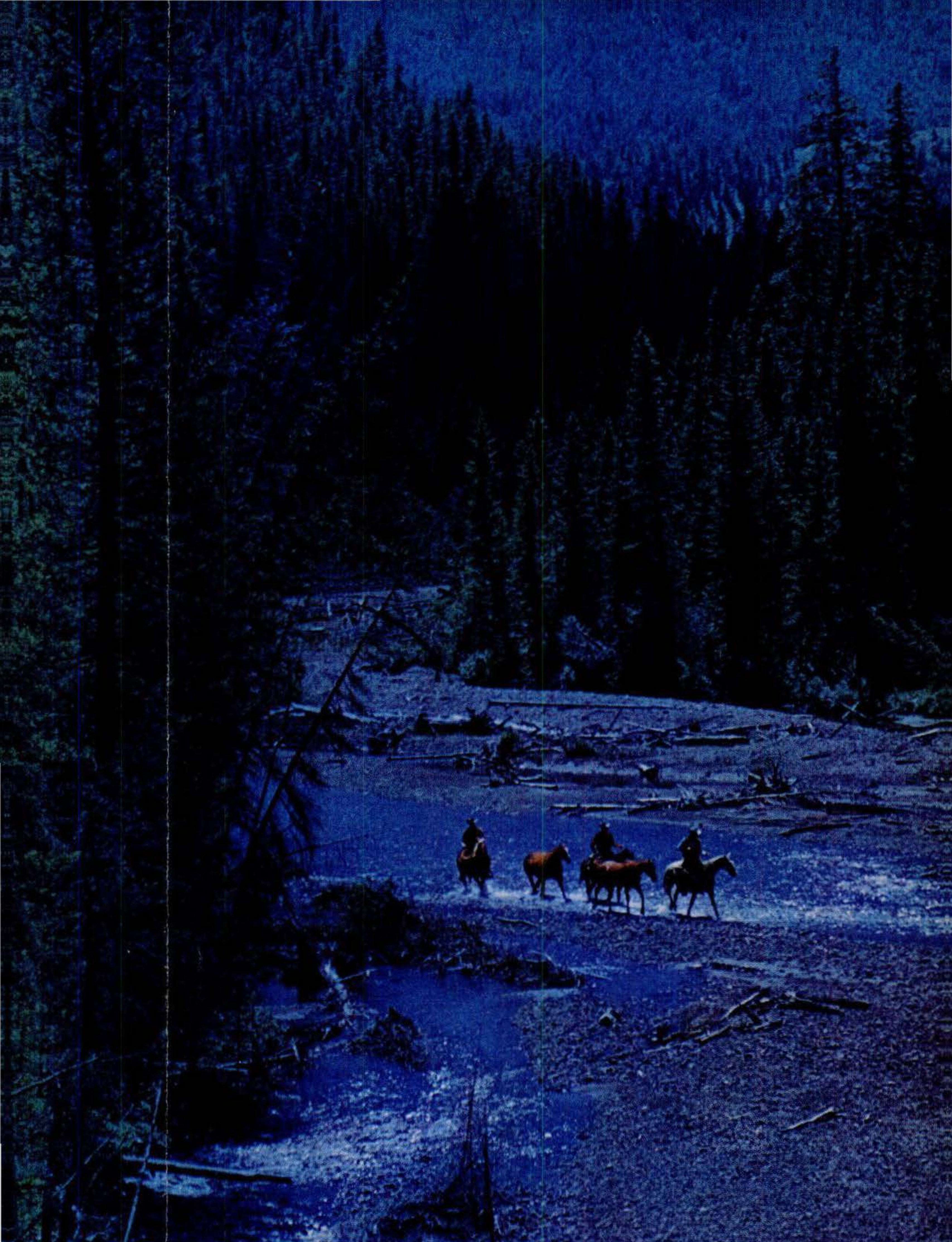
To see how it works
FOLD OUT



How the Gas Turbine Works

Air enters the compressor at the top, then is ducted through two regenerative heat exchangers (one on each side—heated by the exhaust gases). The heated, compressed air then enters the combustor, where fuel is continuously injected. The mixture is ignited and expands. The gas flow is ducted through a turbine, which drives the compressor shaft. The gas flow goes on to drive a second (power) turbine, which has no mechanical connection with the first one, but whose shaft is geared to the transmission — and drives the car.





Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

18 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report Feb. 73

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**Come to where the flavor is.
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How to beat the odds on the long shots.

Here's why many of the people who know rifles best put their money on the Remington Model 700.

When you finally get a bead on the big one—a trophy ram, or goat, or pronghorn—you know how many shots you're going to get.

One.

Making that kind of long shot takes a lot of practice. It also takes a lot of rifle.

The Remington Model 700 bolt action is a lot of rifle. That's why so many people with gun savvy recommend it for long-range shooting.

Ask a veteran hunter—a guy who's bagged the big ones time and time again. The Model 700 is so accurate we used its design as the basis for our classic 40XB Bench Rest competition model. Before we ship a 700, we test it carefully for accuracy. If it doesn't measure up, it never leaves the factory.

Ask a gunsmith. He knows gun design inside and out. He can tell you that our Model 700 has one of the strongest center fire bolt actions ever made. The cartridge head is surrounded by three rings of solid steel. And there are no extractor cut-aways to weaken this critical area. The bolt lugs are machined from steel every bit as strong as the steel around the cartridge head.

Ask a dealer. He probably sells hundreds of rifles a year. You might find out from him that the variety of

the Model 700's caliber selection sets it apart from any other bolt action rifle. It comes in 17 different calibers, for every kind of hunting, every kind of game.

Beyond accuracy. Accuracy and versatility are only a part of the 700 story. Because we know a sportsman

takes special pride in owning a finely crafted firearm.

The Model 700 BDL "Custom Deluxe" is a finely crafted firearm. And it looks it.

Its classic Monte Carlo stock is made of select American walnut. We bring out the rich grain with Du Pont RK-W, a high-lustre finish that's also scratch- and water-resistant.

We've given it deep, traditional checkering to accent the natural beauty of the wood. And added white line spacers and a black fore-end tip to set it all off.

The BDL also has a hinged floor plate, "jeweled" bolt, and a sling strap with quick-release swivels. A real buy with prices starting at \$174.95*.

The Model 700 ADL "Deluxe" offers, among other features, a Monte Carlo stock, skip-line checkering, and Du Pont RK-W wood finish. It's priced from \$154.95*.

One more thing you ought to know: Once you've picked the right rifle, pick the right ammunition to go with it.

Remington ballistics know-how and top-quality components make Remington "Core-Lokt" center fire cartridges the logical choice. They're made for your Model 700. In fact, each 700 is tested with them before it leaves the factory.

The Remington Model 700 and "Core-Lokt" cartridges. Put them together and you've got a shooting system that's hard to beat for reliability and accuracy.

Remington Reports are based on information direct from the Remington experts who design and engineer our products. For more details and a free copy of our full-color catalog, send a postcard to: Remington Arms Company, Inc., Dept. 348, Bridgeport, Conn. 06602.

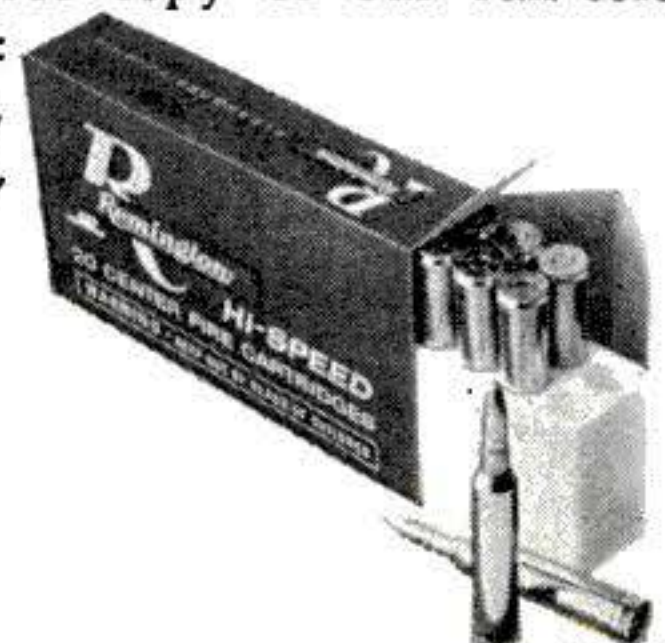
MODEL 700 CALIBERS

17 Rem.
22-250 Rem.
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223 Rem.
25-06 Rem.
6 mm Rem.
243 Win.
270 Win.
30-06
308 Win.
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264 Win. Mag.
6.5 Rem. Mag.
350 Rem. Mag.
300 Win. Mag.
375 H & H Mag.
458 Win. Mag.
Left Hand Version
270 Win.
30-06
7 mm Rem. Mag.

Remington 

Great guns deserve great ammunition. We make both.

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*Prices shown are suggested minimum prices. Subject to change without notice.



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A New Program to Protect Your Invention PAGE 36

How you can use a simple and little-known Patent Office service.

For the Gas Turbine Car, It's Now or Never PAGE 56

Is this the real auto engine of the future? The gas turbine now looks like the best for coping with fuel shortage, emission problems.

How Science Tracks Down the Dread Twister PAGE 64

Doing his research, PS reporter sees an Oklahoma town wiped out.

The Hassle Over Atomic-Energy Safety PAGE 78

Will the big new atomic power plants be able to prevent all hell from breaking loose in the event of a major loss-of-coolant accident?

20 Pages of Home-Improvement Ideas STARTS PAGE 86

Put a bedroom in your attic . . . A bathroom in a dormer . . . Better-than-real stone and brick . . . "Dirt-cheap" soil cement . . . and lots more.

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What's New DIGEST

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Actual scene from a DieHard commercial.

It was old car, old DieHard® vs. new car, new battery. And old won.

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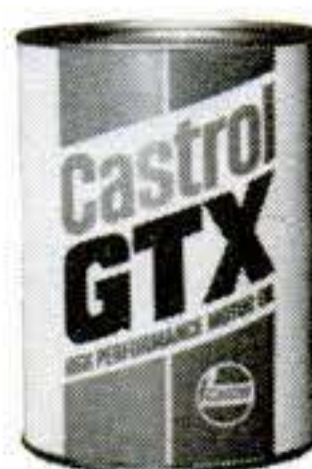
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**Bogus-Money Detectors:
Can They Keep Counterfeit
Cash Out of Your Pocket?**

**Picking Your '74 Car
for More Miles per Gallon**

**Aboard the Supersonic
Concorde . . . You'd Never
Believe It's Mach 2**

**10 Pages on Home Heating:
Beating the Fuel Crisis**

**Behind-the-Scenes Story
of the Rescue of Skylab**

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GENERAL  ELECTRIC

PS Readers Talk Back

Where you voice your views . . . and the editors do the listening

Prescribed sunglasses

Richard Day's article "Beat the Squint—with the Right Sunglasses" [July] was excellently presented and should be of tremendous help to the layman in selecting quality sunglasses. However, the paragraph that reads "The surest place to get the higher priced ophthalmic-quality sunglasses in plano or prescription



is from an optometrist" is a bit unfair to the many ophthalmologists who dispense their own plano and prescription glasses, and the ethical dispensing opticians throughout the country. Why not include them all?

W. D. STAYMAN
Bausch & Lomb, Miami, Fla.

Lithium-battery pacemaker

Concerning "Lithium Batteries—Fantastic New Dry Cells You Can Buy Now" [May], we thought you'd like to know there are medical applications for this cell. We have developed a new lithium iodide pacemaker which is presently in clinical evaluation. Calculated and extrapolated data promises to enable us to deliver a pacemaker of much greater life than is presently available from the universally used zinc-mercury batteries which have given only two-to three-year pacemakers.

MANUEL A. VILLAFANA, Pres.
Cardiac Pacemakers, Inc.
St. Paul, Minn.

Old inflatable bumper

The inflatable bumper shown in What's New [July] is a new unit based on an old concept. In 1916 an inventor named Blalock built about 20 such bumpers. It was a vast improvement over the spring-steel bumper, which didn't fare very well with telephone poles, a big hazard in those days.

Blalock demonstrated his invention for the Missouri State Highway Department and the AAA. A test car equipped with the bumper was intentionally driven into a telephone pole. Damage to the bumper was

minimal, but the pole shattered and smashed into the driver's compartment killing Mr. Blalock. That ended further development of the bumper and any future interest in it. I'm glad to see its revival.

J. L. TORRENCE, Pt. Richey, Fla.

Kit, not a cover

"You've Got the Pool . . . Now Look What You Can Add" [June] mentions our company as manufacturers of a chemical pool-winterizing cover. That's an error. It is a winterizing chemical *kit* that we manufacture; in three sizes, for various pools. We've had numerous inquiries, but for the wrong product. We hope you can correct the error.

NAT JONAS, N. Jonas & Co.
Philadelphia, Pa.

The real '74 Mark IV

As a real car nut I look forward to your annual car preview ["The '74 Cars: More Changes Than You Expected," July]. But I think you made a mistake. You show a picture of what you say is a 1974 Continental Mark IV. The caption reads: "Continental Mark IV keeps its Rolls-Royce-inspired grille." The grille doesn't look anything like its former grille or even a Rolls grille. In fact it looks exactly like the picture of the Torino opposite. Please show us the real 1974 Mark IV.

WARD KOPPEL, Sacramento, Calif.



Several others caught the error. Shown above is the real Mark IV.

Golf cart: clean transit

G. C. Corrigan's letter [Readers Talk Back, July] tells Detroit what kind of car he would and wouldn't buy. I suggest he get a set of golf clubs and a golf cart. Otherwise he may have a long wait to keep to his ultimatum.

W. F. LAWSON, Santa Rosa, Calif.

Wankel questions, anyone?

I'm writing a book tentatively titled *Illustrated Guide to Wankel Engines*. I'm planning a question-and-answer chapter on the engines, *Continued*

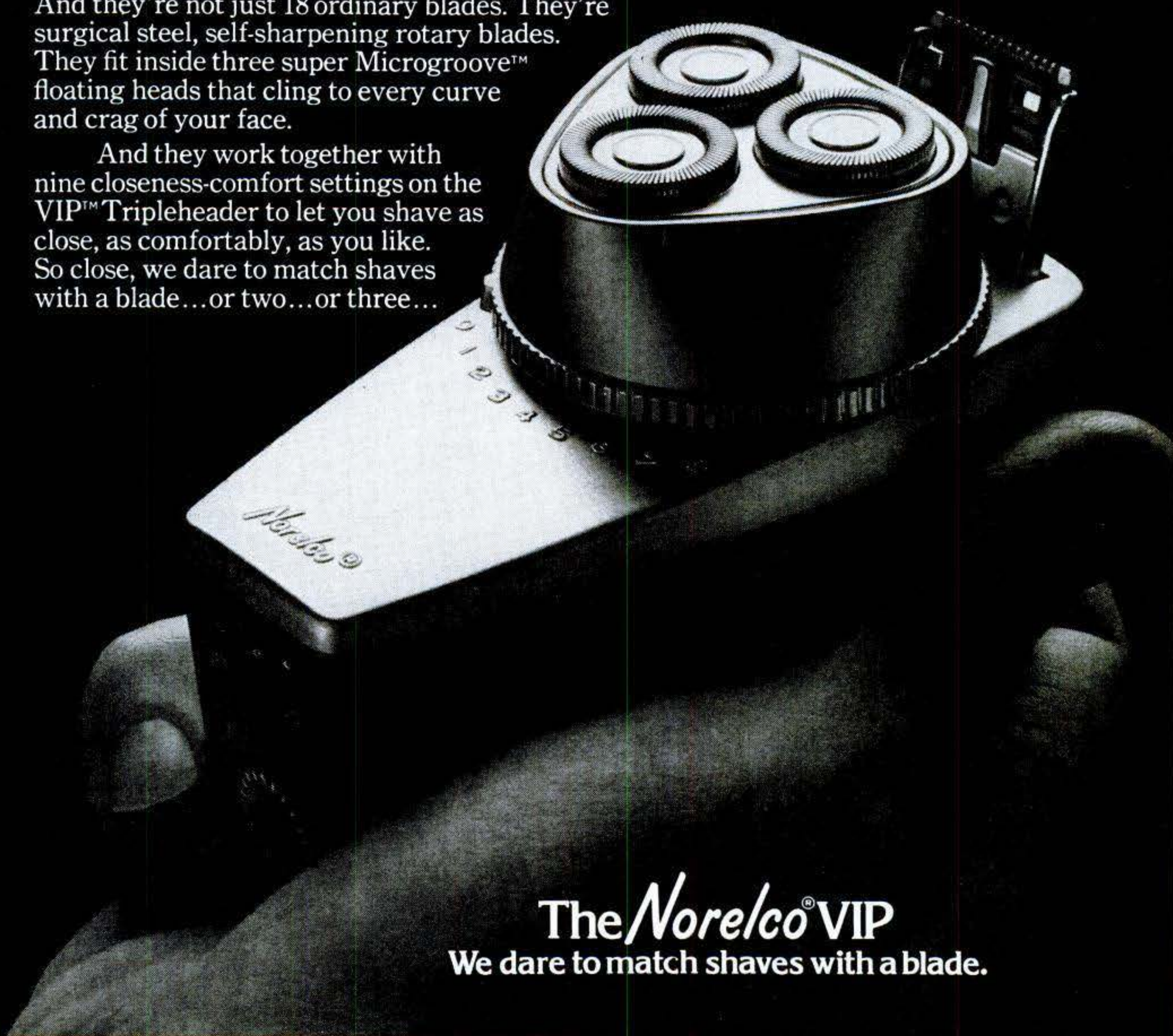


If two blades are better than one... try 18 of them.

Some blade-makers are saying that it takes more than one blade to get a close shave.

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We dare to match shaves with a blade.

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PS Readers Talk Back

[Continued]

and I'd like to solicit the aid of **POPULAR SCIENCE** readers. Send me your questions on Wankel engines. I will



answer each and every letter personally at a later date.

RALPH S. GOBEL, Williamsport, Md.

Readers can send questions to Mr. Gobel at 8A Milestone Garden Apts., Williamsport, Md. 21795.

More on engine run-on

In the diagram for my article "Does Your Car Engine Run On When Switched Off" [June], the four wires leading to the voltage regulator don't match any particular car. However, for many Chevy models and other GM cars, the wire to be cut (for diode insertion) is a *brown* one on the *end*. But check it out as described in the article.

W. S. ANDARIESE, Berlin, N.J.

Parts-supply gaffe

Thanks for the additional publicity in your article "Mist Switch—It's For Your Windshield Wipers" [Aug.]. But someone inadvertently included Heath as a source for components. Unfortunately, our distributors are only authorized to sell parts for Heathkit items.

EARL BROIHIER, Heath Co.
Benton Harbor, Mich.

We're sorry we goofed. Parts for the project may be obtained from Williams Electronic Supply, 1863 Woodbridge Ave., Edison, N.J.

Clean water for pools

I'm glad to see such articles as "Keep Your Pool Water Swimmable" [July] in **POPULAR SCIENCE**. Lately, you seem to be stressing not only clean water, but clean air and cars, and preservation of the environment. I steal my husband's copy whenever he's not looking. Keep up the good work.

NANCY SCALE, Seneca Falls, N.Y.

Clean-engine story [continued]

I've just decided to stick to second-hand junkers until Detroit comes up with something good. And I don't mean internal combustion. Why are they so bull-headed? And then they have the nerve to complain about too-stringent emission controls?

What about the Stirling engine? And Wally Minto's Freon job? Or

the KROV? These are naturals that don't need emission-control devices, and they don't require the complicated tuning up that the internal-combustion engine does.

If Detroit is objecting to retooling, I won't accept that, either. Do these alternate engines require more retooling than the Wankel? Even if they did, wouldn't their advantages more than make up for it?

HENRY CROUCH, Falls Church, Va.

Setting sailing straight

I would like to set the record straight in Peter Stevenson's article "Manta Shows Other Sailcars Its Wake" [June]. **ALSO** (American Land Sailing Organization) is no longer, and has been absorbed by the National Sand Sailing Association, 7305 Van Nuys Blvd., Van Nuys, Calif. 94105. NSSA was organized in 1963 and holds regularly scheduled spring and fall meets. Most of the sailing is done at El Mirage Dry Lake, but we have had special events at Las Vegas sponsored by the Tropicana Hotel and have others coming up, such as Pismo Beach.

We welcome any Manta sailor if his vehicle is properly equipped with a seat belt. We favor no particular land sailer or sailcar.

BOB ASHLOCK, Pres.
NSSA, Van Nuys, Calif.

Pumpkin Seed: Triple Nickel

Here's a photo of my "Fast New Sailboat You Can Build" [May, '72]. I started it the third week of that May and finished it on Sept. 1. It was fun to build, but the real pleasure came when I launched my Pumpkin Seed. She handles nicely in light and moderate air. The sail



number (555) inspired the name "Triple Nickel." Total cost of the project, including sails, was only \$600.

ALBERT HADDOD, Elmira, N.Y.

Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017

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All you need is Master Charge or BankAmericard if you don't have cash around the house or your checking account is low.

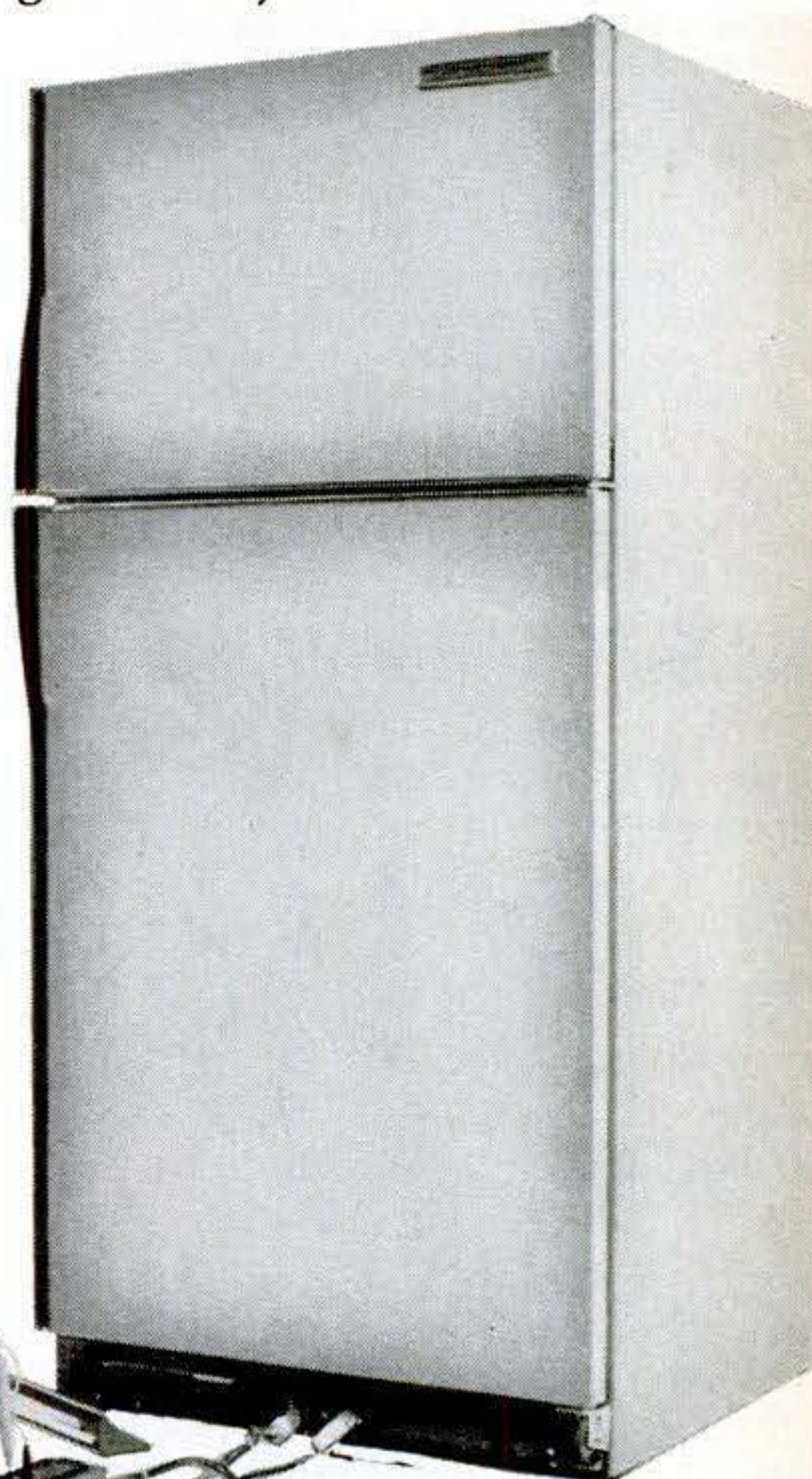
GE Customer Care...Service Everywhere: General Electric's pledge that wherever you are or go in the U.S.A., you'll find a qualified GE serviceman nearby.

Should you ever need him.

Good Service...another reason why GE is America's #1 major appliance value.

Now we can find the trouble in your refrigerator in minutes without messing up your kitchen.

In the old days, you'd have ice cream in the sink and parts all over the kitchen. Now, most of our no-frost models have Rapid Electrical Diagnosis. A system that starts with a computer check of all electrical circuits at our factory. It lets our factory technician check out the main electrical components in about six minutes.



GENERAL  ELECTRIC



Peugeot 504 GL with standard sunroof is in foreground. Behind, left to right: front-wheel-drive Audi 100 LS, Volvo 144-S, and front-wheel-drive Saab 99 LE.

PS Ratings—Test Report in a Nutshell

The table below shows our ratings for 10 performance or design areas in the four vehicles tested. The ratings are based strictly on test results and actual measurements. Personal bias or subjective opinion play no part, as the ratings have a direct mathematical relationship to test data and specifications. Five points is excellent; 4, very good; 3, good; 2, fair; 1, poor; and 0, very poor.

	Audi	Peugeot	Saab	Volvo
Acceleration	3	1	3	2
Brakes	4	3	4	4
Handling	3	4	4	4
Maneuverability	4	5	5	5
Fuel economy	2	4	4	3
Quietness	1	2	0	1
Ride comfort	(2)	(4)	(2)	(2)
Roominess	3	3	4	4
Visibility	3	4	5	4
Entry/exit ease	5	5	5	5



Smaller than U.S. compacts outside, yet roomier than U.S. intermediates inside, these imported family cars offer remarkable fuel economy

Compacts from Europe— Big-Car Price, Small-Car Fuel Economy

By JAN P. NORBYE / *PS Automotive Editor*
and JIM DUNNE / *PS Detroit Editor* PHOTOS BY DAVE HOUSER

If you're concerned about the fuel shortage, you are probably interested in cars with small and efficient engines. All of these European compacts have four-cylinder engines (85 to 112 hp) giving 17 to 24 miles per gallon. Weak on acceleration? Two of them have performance comparable with standard-size U.S. V8s [PS, Mar.].

Perhaps the Swedish-made Volvo is the only car in this group you're familiar with. There are now some 350,000 Volvos in operation on American roads, and sales continue to grow. Saab is also built in Sweden, but production has been so low that nation-wide distribution in the U.S. has only recently been achieved. Still, there are almost 100,000 Saabs

in use in this country. The French-made Peugeot has been sold on the American market since about 1956, but on a modest scale. There are only 55,000 Peugeots in the U.S., but an expansion program is in the works. Audi is a German car (built by a subsidiary of Volkswagen). A newcomer here in 1970, it has sold

Continued

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We have no magic formula to improve gasoline mileage, but we do know that a properly tuned engine can help. For example, one misfiring spark plug in a V-8 engine can reduce gasoline mileage as much as 12%.

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American-made cars built since the early '60s. Spark plug type and gap, cam-dwell, timing and other important tune-up information . . . it's all here! And it's yours for only \$1.00.

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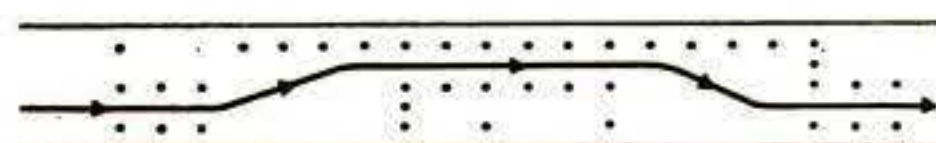
How PS tests brakes—and what we learn from it

We test a car's ability to stop within a 12-foot-wide lane from 60 mph without front-wheel locking. The test is first made with cool brakes to show brake capacity and balance. The same test is repeated after 10 warmup stops from 60 mph with 0.5-g deceleration at one-minute intervals, to show fade resistance. Stopping distance, pedal pressure, and rate of deceleration are recorded. Volvo (above) had the shortest stopping distance with cool brakes, and needed only six feet

more to stop after warmup. Its pedal pressure remained practically unchanged, rising from 80 to 90 pounds. The shortest stop after warmup was made by the Audi—but its pedal pressure more than doubled. Pedal pressure went down after warmup in the Saab, and the Peugeot stopped considerably shorter with hot brakes than with cool brakes. Both front-wheel-drive cars (Audi and Saab) suffered early rear-wheel locking, with attendant lack of stability.



Standardized handling test shows evasive ability



Two lane changes in quick succession show a car's handling precision in a high-speed emergency maneuver. The car swerves left to avoid a barrier in the right lane, then back to clear a left-lane barrier 120 feet beyond. Each car makes a number of runs at increasing speed un-

til its maximum is reached. The Peugeot 504 was fastest, but even the slowest (Audi) equaled Camaro/Firebird speed of 60 mph. Above, two views of the Peugeot show its wide stance, surefooted sidebite, and slight roll. Peugeot has consistent light understeer, uncommonly accurate steering. Saab has excessive understeer, Audi strong understeer, Volvo normal understeer.



PS maneuverability test tells all about steering



Six rubber cones are spaced 48 feet apart in a straight line, and the car snakes a slalom path through them. This is a severe test of the entire steering system. Any deficiency in choice of steering ratio, turning circle, steering linkage, front-wheel alignment, weight balance, tires, or a combination of all, will show

so well that over 50,000 Audis are now registered.

You'll find an accent on quality engineering in these cars that's missing in the usual Detroit product. Audi and Saab have front-wheel drive, and the Peugeot has independent rear suspension (no rear axle but open drive shafts). Volvo and Saab have electronic fuel injection. Volvo has worm-and-roller steering with power assist as an option. The others have rack-and-pinion steering.

All were equipped with optional automatic transmissions. Volvo and Saab use Borg-Warner units made in England. Audi uses a transmission built by Fichtel & Sachs to designs produced in collaboration with the VW engineering department, and Peugeot's automatic is made in Germany by ZF (Zahnradfabrik Friedrichshafen). All use three-speed planetary gearing with a hydraulic torque converter and are fully automatic. The Audi has inboard front disk brakes. Peugeot, Volvo, and Saab have four-wheel disk brakes.

As you can see from the ratings on page 10, these compact sedans have plenty of interior room and are easy to get in and out of. They have superior handling and maneuverability, first-class brakes, comfortable ride, and exceptional visibility.

They compete at Ford LTD/Chevy Caprice price levels, and that is a lot of money for a compact car. But you also get the same luxury or better than you find in full-size American cars. For instance, all have reclining front seat backs, and the Volvo even has adjustable lumbar support. Sunroofs are standard on Audi and Peugeot.

Audi 100 LS. You may think it looks a lot like Mercedes, and there's good reason. The Audi was designed at Mercedes (when VW and Mercedes shared DKW/Audi ownership 50/50—now VW is the sole owner). You find many similarities in the interior layout—the same spaciousness, and the same type of door-handle-cum-armrest design. You find a well-finished passenger compart-

Continued

up in this test. How? By a drop in speed. Each run is timed by stopwatch. The Audi was slowest, and the other front-wheel-drive car (Saab) fastest, in this test. Peugeot and Volvo were within one mph of the Saab's speed. Reasons for Saab's showing: its shorter wheelbase, narrower track, lighter steering, shorter hood (better visibility). Volvo's optional power steering was a big help. Without it, the Volvo is 2.5 mph slower due to high steering effort required.

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Sylvania picture tube

Handsome woodgrain cabinet,
at no extra cost. (Offered only by NRI)

6-position detented
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Modular
construction
with plug-in
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color control

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state chassis

Automatic fine tuning

NOW... learn color TV servicing while building this NEW 25" DIAGONAL SOLID STATE SET created by NRI for home training

NRI wanted more than a hobby kit TV ... so we built one from the circuits up, specifically for teaching advanced electronics. You can only get this superb set from NRI ... it's exclusive with NRI Color TV Servicing Course.

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Kit for kit, dollar for dollar, you get more for your money from NRI.

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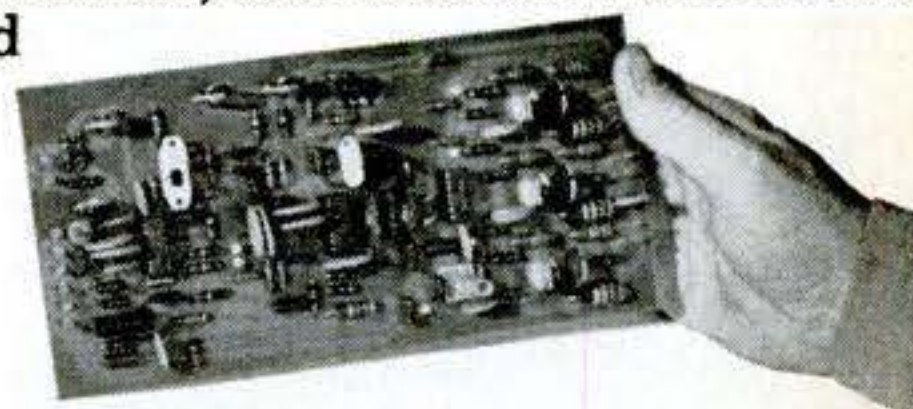
other valuable equipment you will use to perform experiments and make repairs on your own and other sets.



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knowledge of electronics. You can introduce defects into circuits, perform experiments, and discover the how and why of circuitry and equipment operation.



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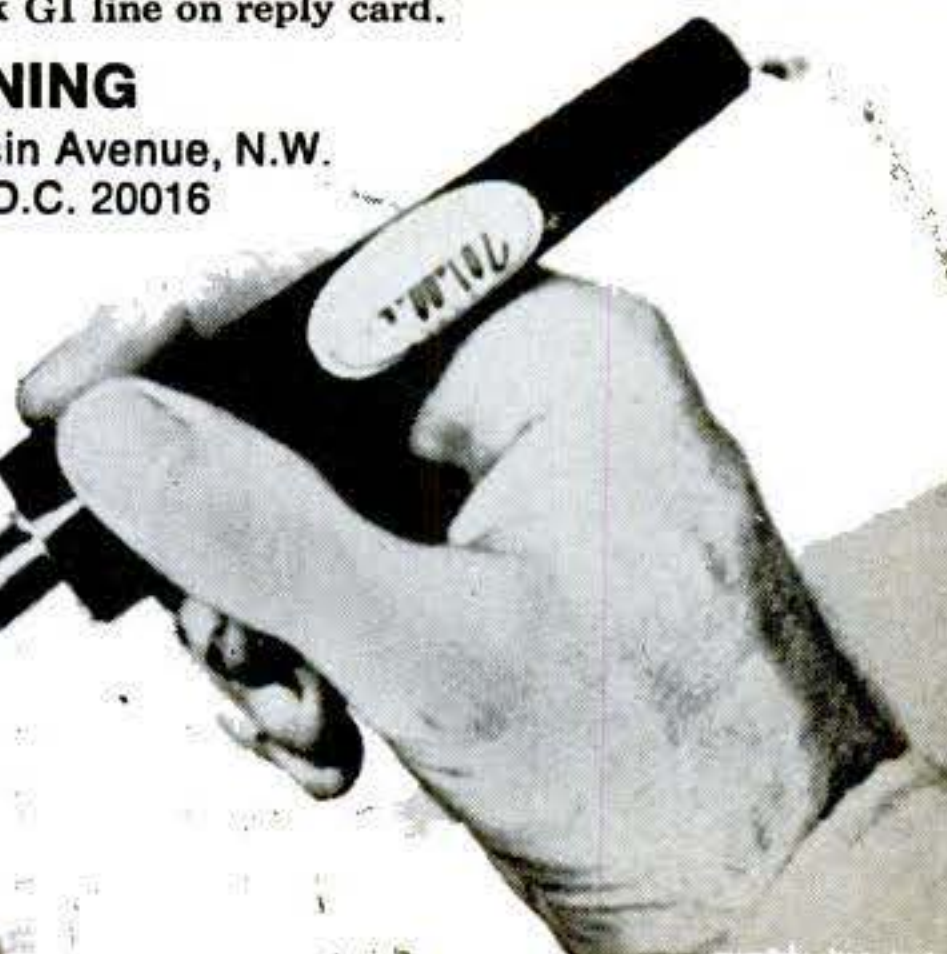
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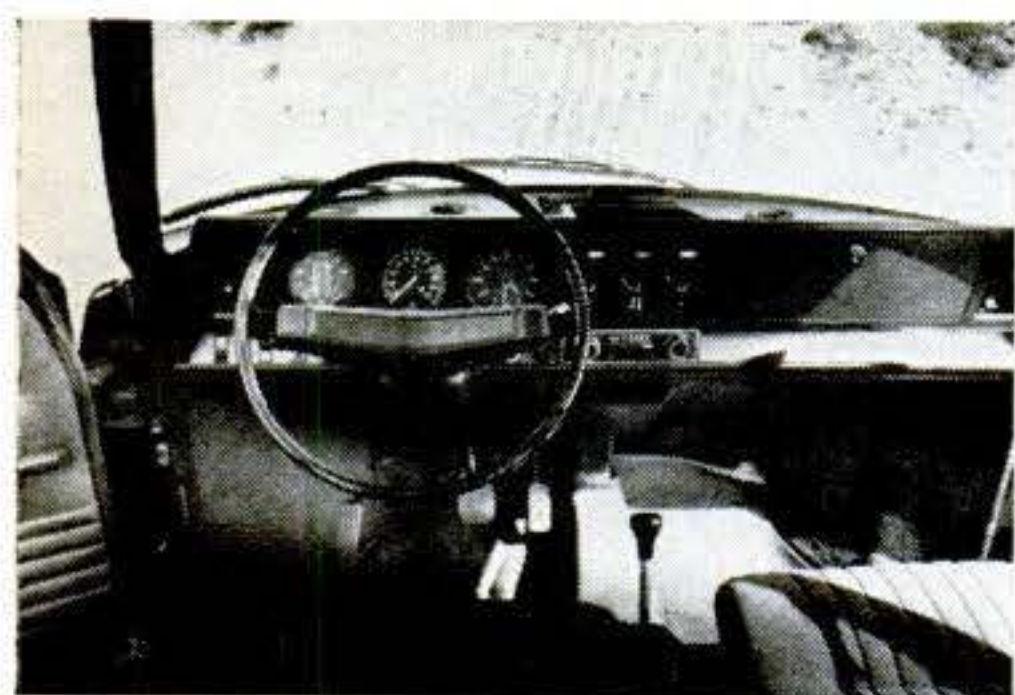
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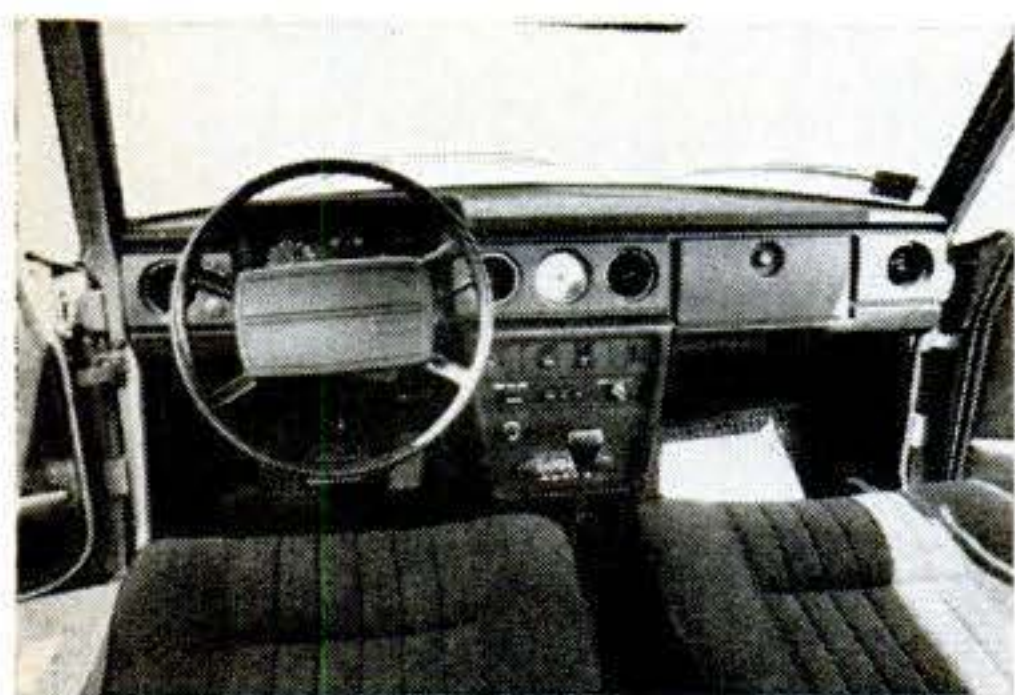




Tracktest fifth wheel and Weston electric speedometer show true speed and record distance with extreme accuracy. This equipment is used in acceleration and brake tests, and to measure distance in fuel-mileage tests. Best acceleration runs were made by the Audi, closely followed by the Saab. Peugeot was slowest, the Volvo leading it by a narrow margin. Surprisingly, the Saab gave best fuel economy, closely followed by the Peugeot. The Volvo ran about three mpg behind, and the Audi six mpg behind the leaders. Both Swedish cars have electronic fuel injection; French and German models use carburetors.



Saab has awkward ignition lock on floor tunnel between seats. Wheel housings intrude, stealing foot space.



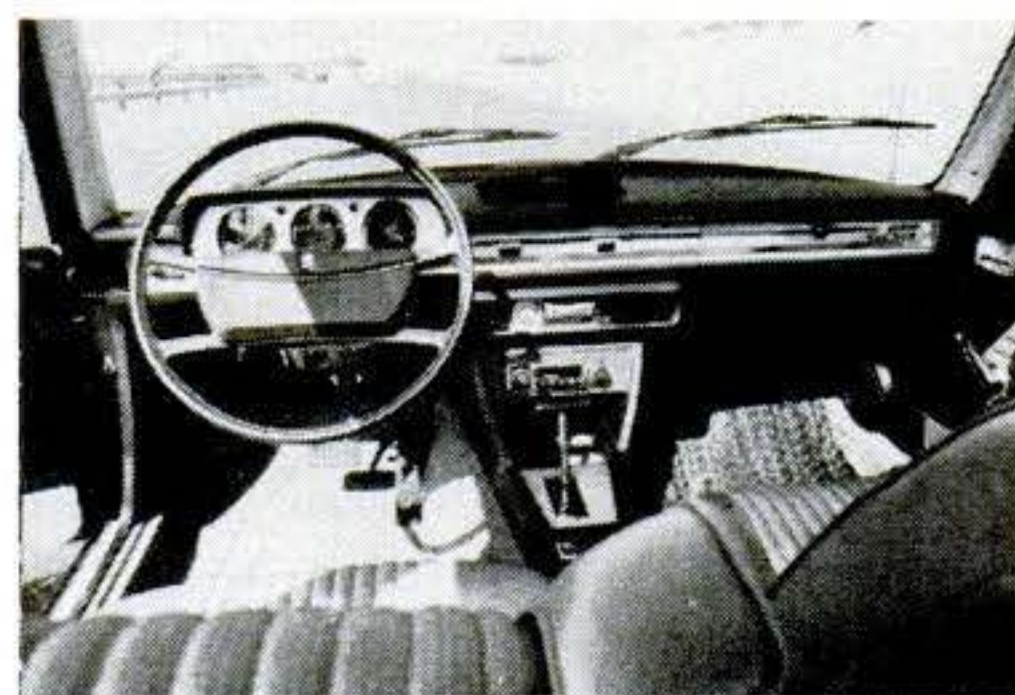
Volvo dashboard looks like model for an ESV with its strong safety accent. New cloth-upholstered seats are great.

ment with full carpeting and a sophisticated ventilation system with easy-to-understand controls. Three-point seat belts with inertia reel are both handy and comfortable.

Windows are very large, and rear view is almost unobstructed. But the hood is high, long, and wide, so that an object on the roadway in front of the car disappears under the car's hood about 16 feet in front of the bumper. (For comparison, the distance is about 12½ feet for the Peugeot, 13 feet for the Volvo, and a mere 11 feet for the Saab. On a U.S. intermediate, like the Mercury Montego, it's over 21 feet!)

An electric rear-window defroster is standard. The instruments are housed in two large dials, with fuel and temperature gauges on the right, and a speedometer optimistically labeled to 130 mph on the left. Automatic choke is standard. The automatic-transmission control lever has an involved lock that requires a lifting motion to engage Drive or Reverse from Neutral or Park. As the pattern is the familiar PRNDL, you'll find that at fast idle the car will lurch backward before you can get it shifted into N or D unless you brake.

The turn-signal stalk also dims the headlights—a very convenient arrangement. A similar stalk on the right controls the wiper/washer system. A bin-type glove box on the lower part of the panel is out of the way—yet the lock is up in the central part of the panel.



Peugeot has unfamiliar controls—such as turn signals and horn in a stalk on the right side of the steering column.



Audi has sparse instrumentation and an automatic floorshift with an awkward movement but excellent seating room.

Peugeot 504 GL. A small luxury car, the Peugeot is advertised as the "French Mercedes" (actually, there's no connection between the two companies). Peugeot is a family-owned business (with certain ties to Renault) that has long traditions as a maker of high-quality automobiles. The 504 GL is the top of the line currently available here.

It is the quietest car in the group, with the most comfortable ride, yet it's also tops in handling—a rare combination, so unusual that all Detroit auto makers bought 504s for testing and examination.

The instruments are set in three circular dials directly in front of the driver, with gauges for battery charging, fuel, and temperature. A dash clock is standard. Some small controls may be confusing, but others give added convenience. For example, the main wiper control is a switch on the instrument panel. But the light-switch stalk on the steering column (left side) also operates the wiper/washer, and has a manual override for intermittent wiping. Very clever.

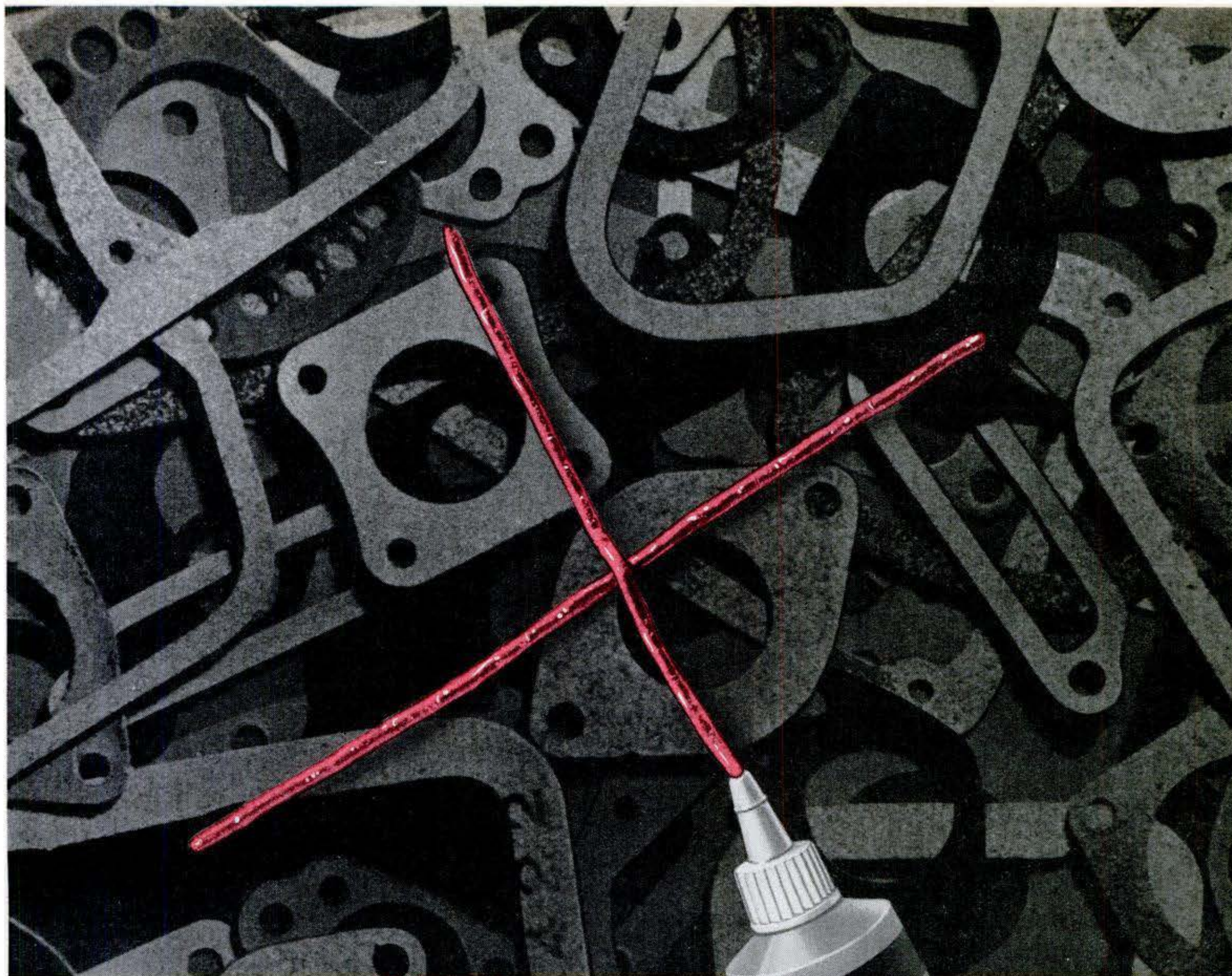
Contrary to normal practice, the turn-signal stalk is on the right. You pull it up to blow the horn—another unaccustomed practice. Heater/ventilation controls are confusing. Four slide levers control heat, fan, fresh air, and upper/lower ducts. The cowl intakes are controlled separately by levers under the panel.

Seats recline fully, and a novel headrest arrangement brings the retracted headrest flush with the top of the seat back. The glove box is lockable. An electric rear-window defroster is standard, but the Peugeot has a manual choke. The handbrake is a convenient pull-up lever between the front bucket seats.

Saab 99 LE. Saab was an aircraft manufacturer before the company took up autos in 1947, and Saab airplanes are regarded as among the most modern in the world. The cars show lots of influence from aviation practice—especially in instrumentation, controls, and safety. The body shell is a tremendously strong steel structure. The instrument panel is unconventional in appearance, but gauges are well placed and easy to read. The speedometer is marked in both mph and kilometers. A dash clock is standard. Controls are fairly standard, except that the wiper/washer system is on a stalk on the right of the steering column.

Headrests are doughnut-shaped to give driver see-through rear visibility and avoid giving back-seat passengers that closed-in feeling. The Saab interior seems smaller, but

Continued



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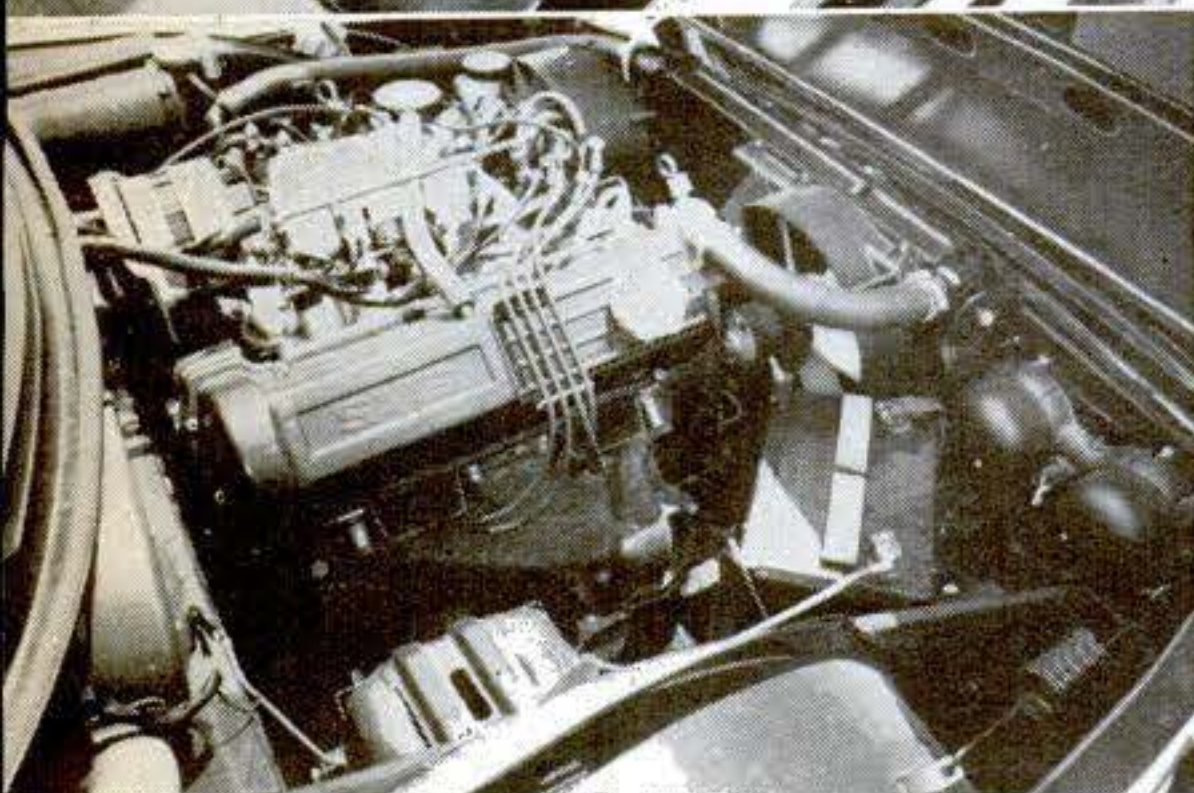
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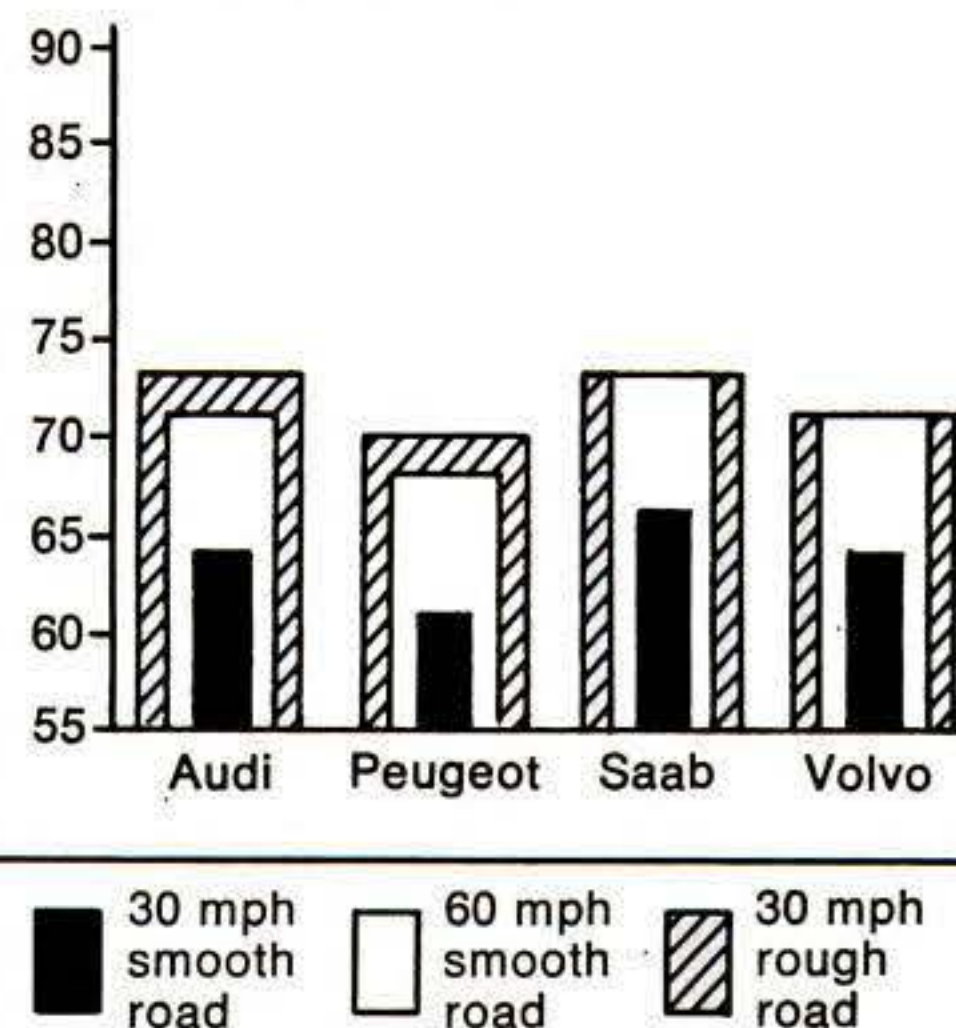


Volvo (top left) offers easy access to underhood service points (though oil filter cannot be removed from above). Peugeot (top right) is slanted right. Plug change is easy, but requires a special

tool. Saab (left) engine stands high with easy access to all service points. Audi (right) carried engine far forward, slanting right. Plugs, underside, are easy to change.

NOISE - LEVEL TESTS

Interior noise is measured in decibels on the A scale on our standard General Radio sound-level meter applied under three sets of conditions. A reading of 50-dBA is like an average residence. A 60-dBA reading is like a large store; 70-dBA, like a freight train going by 100 feet away; 80-dBA, like a pneumatic drill at 50 feet.



Audi trunk (top left) has wide, flat floor, with spare wheel atop rear axle. Peugeot (top right) has spare wheel under trunk floor, accessible from below. Trunk is long and deep, with minimal wheel-hous-

ing intrusion. Volvo (left) stores spare vertically in right-rear fender panel. Saab (right) carries spare (not shown) upright against rear of trunk—easy to reach but in the way.

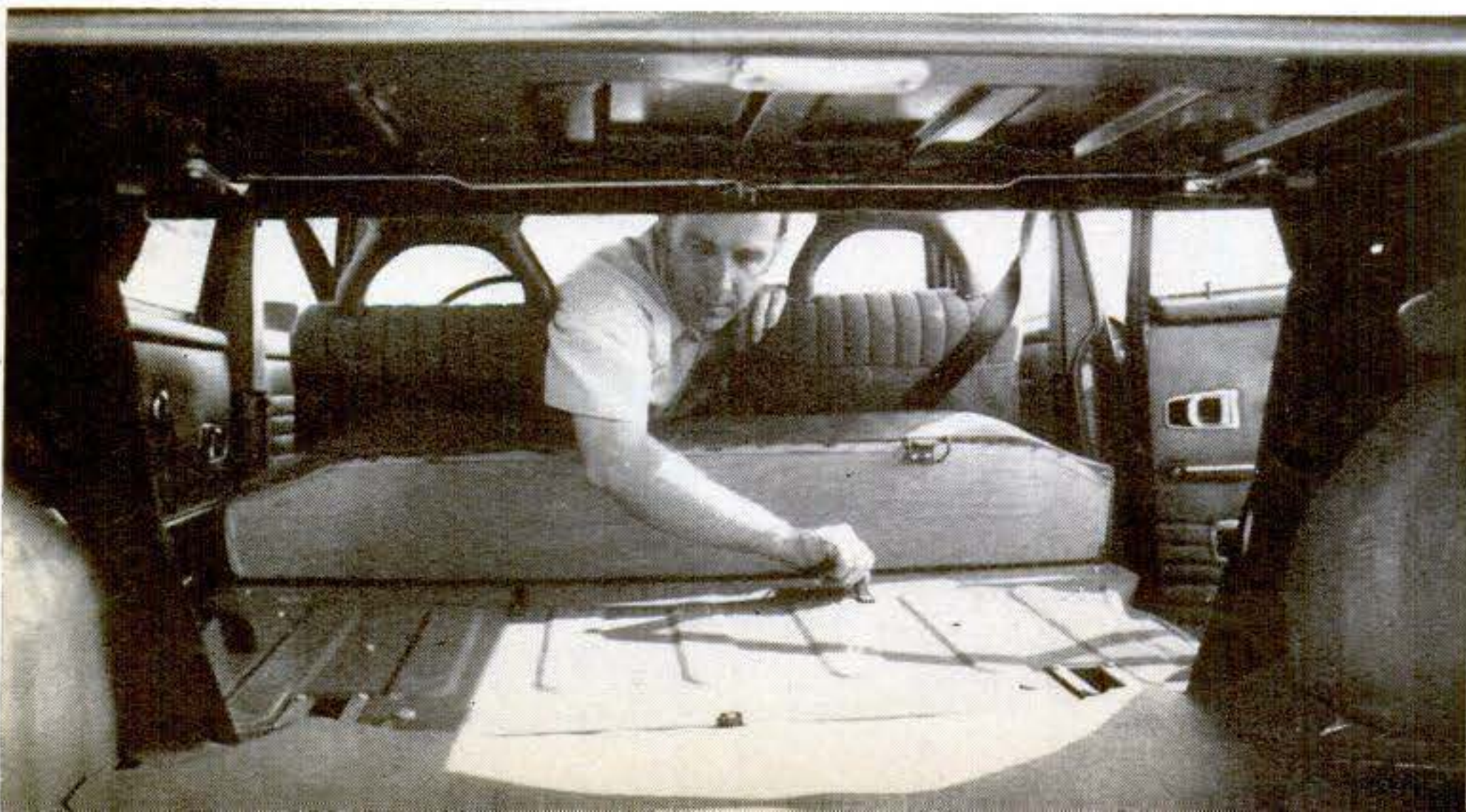
measurements prove it's the roomiest in the group. The front seat suffers from wheel-housing intrusion, however. A small brake pedal is placed well to the right of the steering column, making left-foot braking difficult. The driver has a footrest aft of the left-wheel housing.

The hood is front-hinged but has a complicated two-stage movement (the other cars have normal "alligator" hoods). The rear-window defroster uses a hot-air duct fed by the heater system, which includes lower-level outlets in the rear seat.

Volvo 144 ES. First introduced in 1967, the 144 has evolved into a practical safety car. It is obvious that the Volvo has been designed and equipped with safety as a prime goal. The bumpers are more substantial than others and exceed U.S. standards by a wide margin. The seat-belt arrangement resembles the Audi's and is just as satisfactory. The parcel shelf behind the rear seat is recessed to keep objects from flying under hard braking or in a crash. Instruments and controls are spread widely, some high in front of the driver, others low down on the console head. The handbrake is out of the way, on the driver's left.

Temperature and vent controls are grouped in three centers, with two twist-knobs and a set of pushbuttons. There are four face-level vents on the driver's side. Front doors have

Saab back seat folds down to form load platform flush with trunk floor for carrying large or odd-shaped objects, or for use as a camper.

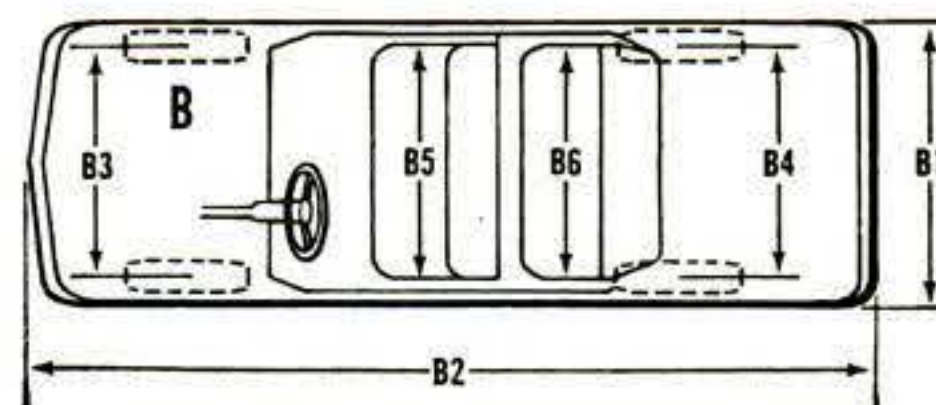
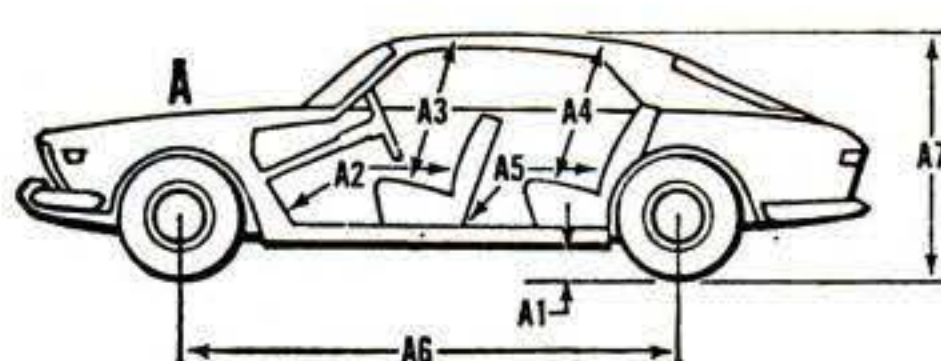




Bumpers meet U.S. requirements on all, but the Swedish bumper systems go beyond. Volvo has seven-inch single headlights, while all others in group use dual five-inch sealed beams. Audi and Volvo have conventional headrests; Saab uses a doughnut design; Peugeot's retract fully into the seat backs.

vent windows (the only one in the group). Heater ducts are led under the floor to the back-seat foot wells. Front seat backs have inertia locks preset to "give" in rear-end collision to avoid whiplash injuries.

The Volvo has gauges for fuel and temperature, warning lights for brake failure, parking brake, oil pressure, and battery charging—all housed in a rectangular cluster. An electric rear-window defroster is standard. The radio antenna is laminated into the windshield. Like the Saab, Volvo uses the Bosch electronic fuel-injection system, which eliminates a choke



DIMENSIONS (inches)	Audi 100 LS	Peugeot 504 GL	Saab 99 LE	Volvo 144 ES
A1 Ground clearance	6.2	6.3	6.89	7.1
A2 Front leg room (max.)	45.5	45.0	44.25	46.0
A3 Front head room	38.0	37.5	38.0	38.5
A4 Rear head room	34.0	34.0	35.0	36.0
A5 Rear leg room (min.)	39.0	38.0	40.5	39.0
A6 Wheelbase	105.3	107.9	97.4	103.15
A7 Height	55.9	57.5	56.7	56.7
B1 Width	68.1	66.5	66.5	67.3
B2 Length	182.1	176.8	172.05	188.0
B3 Front track	55.9	55.9	54.7	53.15
B4 Rear track	56.1	53.5	52.1	53.15
B5 Front hip room	48.0	50.0	51.0	49.0
B6 Rear hip room	57.5	51.0	52.5	50.0

SPECIFICATIONS

	Audi 100 LS	Peugeot 504 GL	Saab 99 LE	Volvo 144 ES
Engine type	OHV 4-in-line	OHV 4-in-line	SOHC 4-in-line	OHV 4-in-line
Displacement (cu. in./cc)	107.4/1760	120.2/1971	121.1/1985	121.1/1986
Compression ratio	8.5:1	8.35:1	8.7:1	8.7:1
Carburetion	one 2-bbl.	two 1-bbl.	EFI	EFI
Net hp @ rpm	85 @ 5100	93 @ 5200	110 @ 5500	112 @ 6000
Net torque @ rpm	100 @ 3000	121 @ 3000	123 @ 3700	115 @ 3500
Transmission	automatic	automatic	automatic	automatic
Axle ratio	3.89:1	3.89:1	3.89:1	4.10:1
Tire make	Semperit	Michelin	Semperit	Goodyear
Tire type	VTT	X-As	VTT	6800
Tire size	165SR14	175HR14	165SR15	165SR15
Steering	manual	manual	manual	power
Overall ratio	21.6:1	22.2:1	19.1:1	17.5:1
Turns (lock to lock)	3.8	4.5	3.75	3.9
Turn diameter	36 ft.	33.6 ft.	33.5 ft.	32.5 ft.
Brake system	power	power	power	power
Type	disk/drum	all disk	all disk	all disk
Disk diameter	11.02 in.	10.75 in.	10.6 in.	10.7/11.6 in.
Drum diameter	10 in.			
Swept area	211.6 sq. in.	438.5 sq. in.	358.2 sq. in.	401 sq. in.
Fuel tank (gal.)	15.3 gal.	14.8 gal.	11.9 gal.	15.5 gal.
Trunk space (cu. ft.)	26	22.5	19.5	24
Liftover height	30 in.	32 in.	30.5 in.	36 in.
Curb weight (lbs.)	2483	2776	2666	2732
F/R weight distribution	59.4/39.6%	54.2/35.8%	61.6/38.4%	51.6/48.4%
Price (basic)	\$4505	\$4230	\$4145	\$4340
Price (as tested)	\$4816	\$4547	\$4460	\$4721

TEST RESULTS

	Audi 100 LS	Peugeot 504 GL	Saab 99 LE	Volvo 144 ES
Acceleration 0-60 mph	14.1 sec.	17.6 sec.	14.5 sec.	16.7 sec.
Acceleration 0-80 mph	28.0	36.6	29.8	35.45
Acceleration 25-70 mph	16.85	20.4	16.55	19.75
Braking (cool) 60-0 mph	150.0 ft.	180.0 ft.	135.2 ft.	130.5 ft.
Pedal pressure	80 lb.	90 lb.	80 lb.	80 lb.
Braking (hot) 60-0 mph	131.4 ft.	149.0 ft.	139.8 ft.	136.4 ft.
Pedal pressure	200 lbs.	160 lbs.	60 lbs.	90 lbs.
Handling test mph	60 mph	64.7 mph	62.4 mph	63.55 mph
Maneuverability test mph	25.3 mph	27.2 mph	27.85 mph	27.0 mph
Gas mileage (constant 45 mph)	17.222 mpg	24.050 mpg	24.403 mpg	21.218 mpg

TEST CONDITIONS: Ambient temperature, 76° F; relative humidity, 66%; barometric pressure, 30.1 inches.

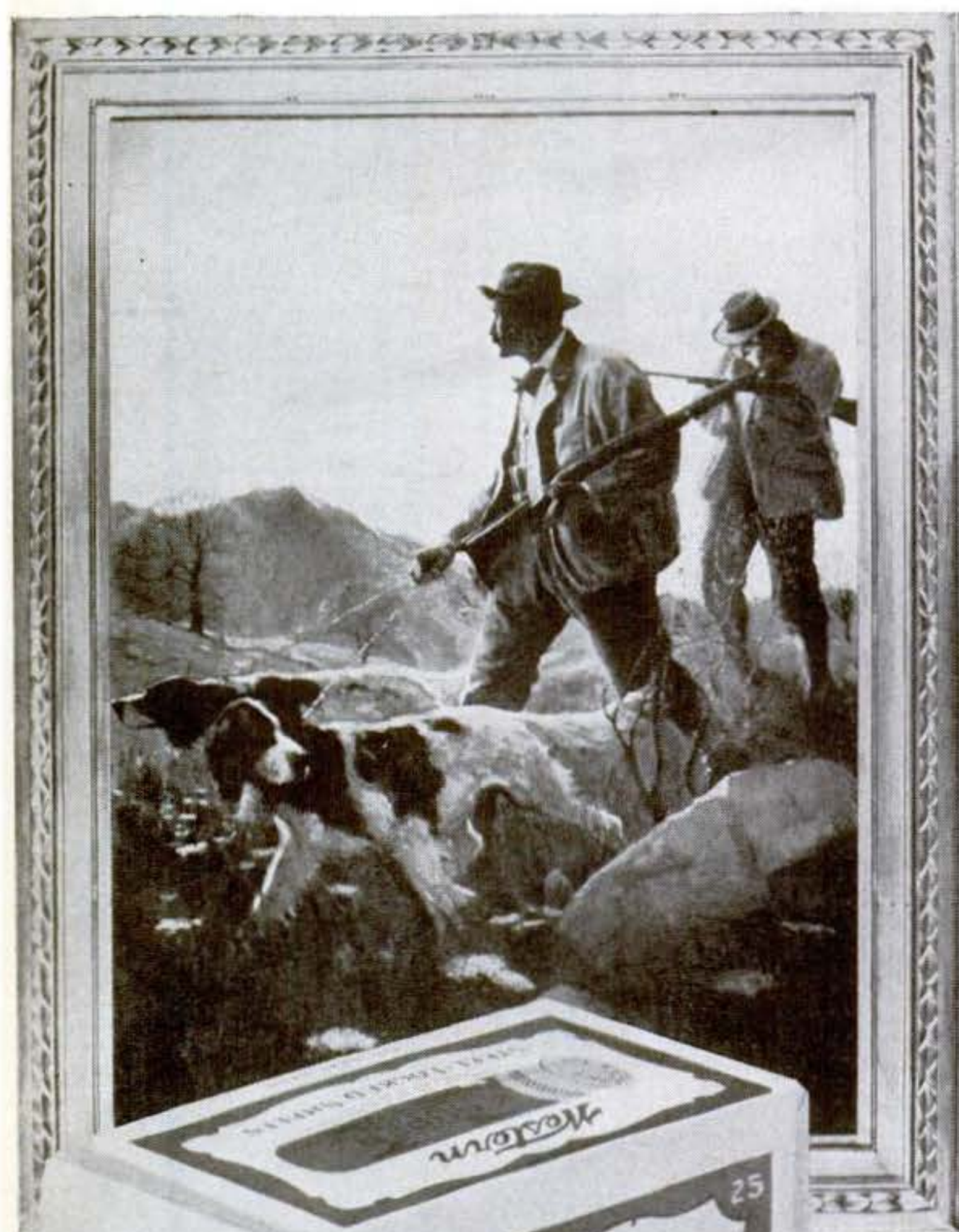
How American '73 cars have fared in our tests

TESTS	CHEVELLE Laguna	FORD Gran Torino	AMC Matador	PLYMOUTH Satellite	DODGE Coronet	BUICK Century Luxus	MERCURY Montego MX	PONTIAC Grand Am	AMC Ambassador	CHEVROLET Caprice	FORD LTD	PLYMOUTH Fury Gran Sedan
Accel. 0-60	13.15	11.8	11.5	13.1	9.75	14.45	10.3	8.75	11.1	13.2	13.15	12.05
Accel. 0-80	22.6	21.55	21.0	23.95	18.1	27.1	18.25	15.7	21.7	27.55	25.85	21.8
Accel. 25-70	14.15	12.65	12.75	14.1	10.75	16.25	12.2	9.35	12.45	16.1	15.65	13.45
Brakes 60-0 (hot)	186.9	134.0	160.1	156.2	148.3	172.0	157.8	153.0	158.2	206.5	164.1	182.9
Handling (mph)	53.0	58.2	53.0	56.3	53.0	54.5	49.9	60.0	56.3	53.0	53.0	53.0
Maneuver (mph)	25.3	23.9	23.9	22.1	25.0	24.6	22.1	26.0	25.3	24.6	25.3	23.3
Fuel mpg (45 mph)	14.5	14.7	14.3	15.2	14.2	12.3	10.8	14.2	14.1	10.9	14.2	11.7
Noise (60 mph)	69dba	68dba	70dba	70dba	67dba	69dba	64dba	64dba	68dba	64dba	64dba	66dba
Price	\$3924	\$4126	\$3681	\$3489	\$4204	\$4089	\$4554	\$5705	\$5060	\$5126	\$5070	\$5107

device for starting. The Swedish cars not only get better performance and gas mileage from fuel injection, but also better driveability. You can drive off as soon as the engine fires up. There is no fast idle, either. The

engine just purrs normally, even on a cold morning. The transmission engages smoothly (since idle speed is low) and the engine won't stall. Turning the key off shuts off the fuel, so the engine never runs on. **P 5**

Why the history of shot shell development in the last 50 years reads a good deal like the history of Winchester-Western.



1922 The introduction of Super-X, the original long range load with a short shot string, started a chain reaction of improvement that has continued to this day. The vastly improved power and performance that the use of progressive-burning powder gave in Super-X shot shells opened new areas of opportunity for further development. You, the hunter and shooter, have been the beneficiary.

1923 We introduced Seal-Tite composition wads to contain the power generated by the new Super-X load. 1923 also saw the introduction of a 3" shell with a shot weight of $1\frac{3}{8}$ ounces, a far cry from the 1 ounce that had been the standard waterfowl load for decades.

1926 The years from 1922 to 1926 saw continual improvement in Winchester and Western powders; and in 1926 we introduced Lubaloy (copperized) shot. Greatly reducing barrel scuffing of shot, the harder Lubaloy gave (and still gives) waterfowl hunters magnificent dense patterns.

1936 As powder improvement continued, other developments kept pace. 1936 brought two important innovations. The first was our overlay cup base wad that further improved gas retention and prevented swelled heads and blown rims due to rearward leaking gas. The second introduction was a rifled slug with vanes that stabilized it as it moved through the air. The resulting accuracy set new standards for shotgun slug shooting.

1945 Three major improvements in shot shells were introduced by Winchester-Western as World War II ended. One was a patented flanged cup wad over the powder. An integral part of the Sealed Gas Chamber, it expands on firing to seal gas and power behind the shot, eliminating blown patterns caused by leaking gas that can melt or deform shot as it passes down the barrel. The other two developments were the new use of a high wet strength paper to resist swelling and scuffing, and the addition of micro-crystalline wax to aid waterproofing.

1946 This year brought an innovation that revolutionized sporting powders — Ball Powder. A unique Winchester-Western development, it gives shooters clean, cooler-burning powder that meters precisely and packs uniformly.



Today's unique compression-formed Super-X and Upland shot shells are only the latest in a long line of innovations.

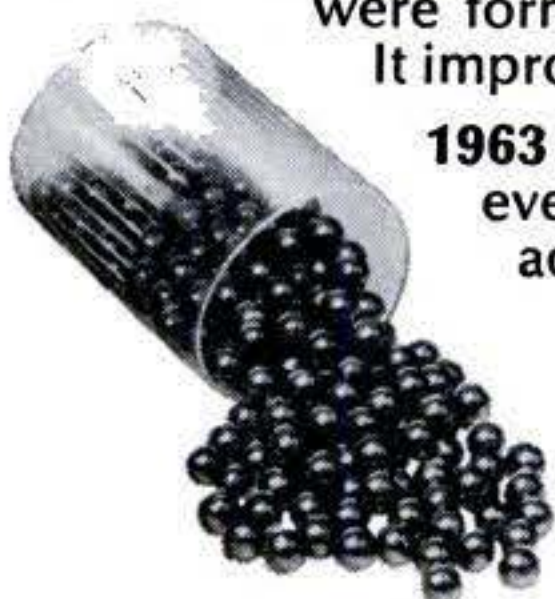
1948 Our new molded fiber filler wads produced further cushioning of the thrust of ignition, adding still another factor to improve pattern performance.

1954 Baby magnums, a 2¾" load with the shot weight and total punch of a larger shell, were introduced by Winchester-Western. The result was to make every shotgun a magnum, if it had a 2¾" chamber.

1958 For those magnum shooters who had a three-inch chamber, we introduced the dream of every long-range waterfowler: the 3" magnum in a 1⅞ ounce load, roughly the equivalent of a 10 gauge.

1959 We gave shotgun deer hunters a new 12 pellet 00 buck load, a long step over loads previously available.

1961 A tremendous advance in shot shell performance came with the advent of our Mark 5 protective collar. This device shields the shot column from contact with the barrel and eliminates wild pattern-destroying pellets that were formerly scrubbed flat by that contact. It improved patterns by 10%.



1963 The Super Buck Shot load gained even better performance through the addition of powdered polyethylene to the shot columns. This cushions pellet-to-pellet deformation at the moment of ignition.

1964 This was the really big year because it saw us introduce the revolutionary compression-formed

plastic shot shell case, a case tough enough that it can be fired without the metal head. The new concept eliminated base wads and provided a case so strong it set whole new standards for reloadability. Originally, it was introduced only in our Super-X brand.

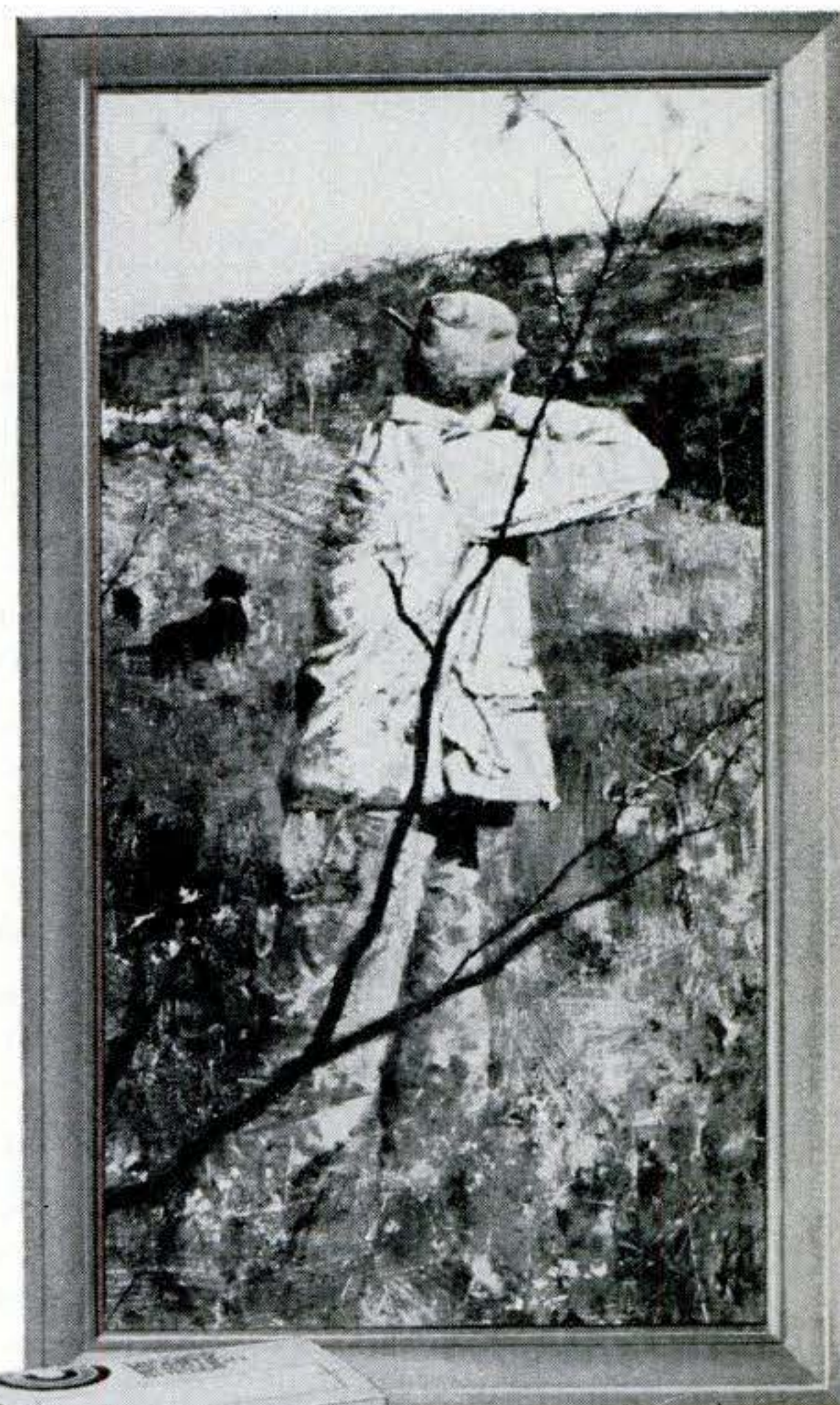
1965 Recognizing the inherent advantages of the plastic hull, Winchester-Western developed a new line of skeet and trap loads, named AA, with the one-piece, compression-formed case. Their acceptance was immediate and enthusiastic, and their popularity continues unabated.

1969 The powdered polyethylene principle used so successfully in Super Buck Shot loads was applied to 2's and 4's in a new load known as Super-X Double-X. The result? Patterns up to 90% at 40 yards and an amazing capability at normal hunting ranges.

1971 We introduced Upland, the first and only low base compression-formed shot shell for the shooter who guns for quail, rabbits, woodcock, grouse, partridge and other lighter game. Its tough plastic case, capable of many reloads, brought a truly premium product to upland hunters at no extra cost.

Today Add it all up — today the hunters and shooters of America are the beneficiaries of Winchester-Western's purposeful dissatisfaction with things as they are and our constant search for a better way and better performance.

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"Say, Smokey—"

A clinic on cars by America's most famous mechanic

Each month in *Popular Science* Smokey Yunick answers questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Send it to: "Say, Smokey—" *Popular Science*, 355 Lexington Ave., New York, N.Y. 10017. Questions cannot be answered by mail.

Smoky exhaust

My 1970 Torino 351 with 30,000 miles on it has always done a good job of pulling a 1200-pound trailer. It still runs good under normal driving conditions. But recently when pulling on any long mountain grade under full throttle, the engine throws heavy black smoke out of the exhaust. I suspect the choke is closing. Any suggestions?

FRANK J. MON, Pittsburgh, Pa.

When you open the throttle you get more fuel, but for some reason not the proportional amount of air with it, so the mixture is too rich—hence the black smoke. Man, you are polluting the hell out of things. Look for a restriction in the air cleaner, also for failure of the ignition to be in the proper advance condition under heavy pull, or a low-vacuum situation. Or look for a carburetor in an overrich condition that occurs at a high throttle angle. This would catch the possibility of improper choke operation.

Broken starter housings

My problem is that I took the engine out of my '66 Corvair to install oil seals, etc., and after putting it back in I keep breaking the starter-motor housings when I try to install them. So far the score is three broken housings. What am I doing wrong?

J. H. RUSSELL, Powell River, B.C.

Your problem is simple; misalignment of the starter motor and improper mesh of the starter drive. But the mystery is how you did it. So back to the starter mount area and try to find what is causing the starter to be too close, or too far, from the starter ring gear. Also check the condition of the flywheel and the starter-drive teeth, either of which could be bad. The usual cause of a broken starter housing is pressure that's trying to force the ring gear and drive apart.

Automatic trans for 4WD?

I'm thinking of buying a four-wheel-drive pickup. I was wondering if I should get it with a four-speed transmission or automatic. Some say

that with automatic there is no power loss, and that with it they can do anything that can be done with four-speed. What do you recommend?

CARL BRAUN, Reno, Nev.

When you get right down to it, a manual four-speed is better—assuming you are driving in standard conditions, such as no road at all, or hilly country, or swampy or loose sand. Then expert driving would outdo an automatic programmed shift pattern. But I think the automatic is best for an average, overall deal, when most of the driving would not be in very bad conditions, and considering that most drivers are not experts.

Bad brakes

About two months ago, the brakes on my '64 Dodge started to stick when fully depressed, the pedal only rising slowly until pulled up with my foot. Later, when I pulled up the pedal there was only free play. The brakes still work well but the brake lights come on when the pedal falls to its now normal position. Two mechanics claimed to have pulled the wheels and inspected the brakes, then gave up. A third told me, after working the pedal, that some brake fluid had gotten behind the master cylinder, and though there was no immediate danger, the master cylinder would have to be replaced. My brakes are still down.

PATRICK ROSE, Huntsville, Ala.

I just hope you don't have to read this answer in your hospital bed, because it sounds like you are driving a death trap. The master cylinder is sticking and not returning due to trouble in its piston area, or in the brake pedal and linkage assembly. What is going to happen if you don't get it fixed is that one of these days the piston won't come back far enough for fluid recharge and you'll have a panic situation and no time to pump—and there goes the farm!

Vibrating transmission

I have a 1972 Camaro 350-c.i. with four-speed transmission. The problem is with the transmission: When I shift into second gear and accelerate,

the shifter vibrates. In first, third, or fourth, everything is smooth on acceleration. I took the car to the dealer and they checked the shifter, which was okay. Then they replaced the entire second gear in the transmission but that didn't help any. They say they can't figure it out, and that it's just one of those problems you have to live with. I'm afraid sooner or later something serious might go wrong.

DAVID POLIVCHAK, Largo, Fla.

I doubt if this second-gear vibration will develop into a serious problem—but it shouldn't vibrate. I believe the trouble is triggered by engine-torque resonance, which is not tuned out by the engine mounts. The fix will probably come by changing motor or transmission mounts, or rebalancing the drive-line components. Also simply changing springs in the gearshift and linkage could dampen out the vibration.

Fast spark-plug wear

I have a very hard time trying to keep spark plugs on my '66 Chevy Bel Air 285 V8. Every 20 miles the porcelain breaks loose. I bought the car used, with 48,000 miles on it and I'm on my third set of plugs.

CELESTINO PELINO, Alequippa, Pa.

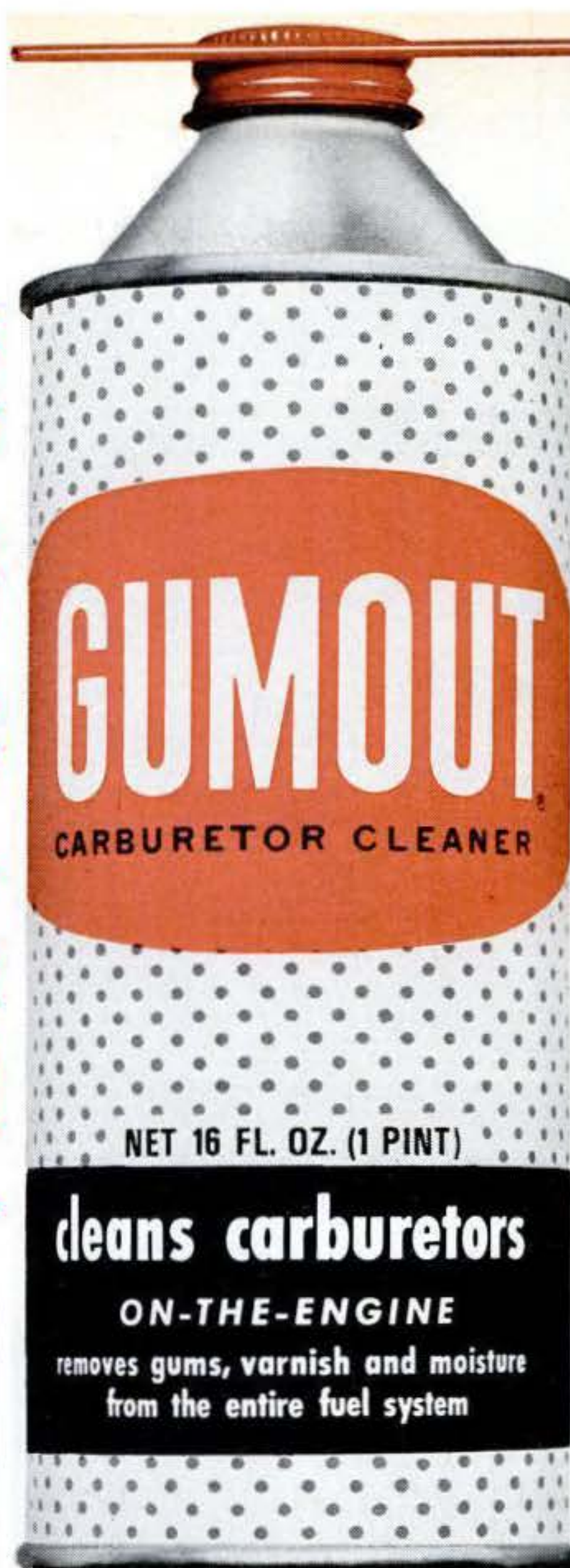
You've really got a weird one there. Only three things I have ever seen break the ceramic: poorly built plugs, plugs way too hot for the engine, or pistons hitting the plugs—and 99 percent of the time it's the last reason, because it's the wrong plug in reference to reach. Your engine uses a very short plug. Of course, too much dome on pistons or too much cut off heads can do it, too.

Clutch trouble

My 1962 Falcon, 170 c.i.d. and three-speed manual, now has over 100,000 miles on it. Though it has been dependable and economical, needing very little repair work, I began recently having trouble downshifting, and the car began smoking badly. Since I wanted to continue using it as a work car, I pulled the engine and transmission. I had the block rebored and installed all new parts to it except the crankshaft, which miked out okay. I replaced the clutch plate with a rebuilt one, but didn't replace the pressure plate.

After I reinstalled it the engine ran fine, but the clutch wouldn't disengage even with maximum adjustment, and the clutch pedal lacked about one inch of returning all the way, although I could pull it up by hand. I checked everything throughout the clutch assembly for bending or cracking, but all seemed okay. Finally in an attempt to get the clutch to disengage, I lengthened by 5/8 in. the clutch linkage that actuates the throwout arm. After that, the clutch would disengage and the ped-

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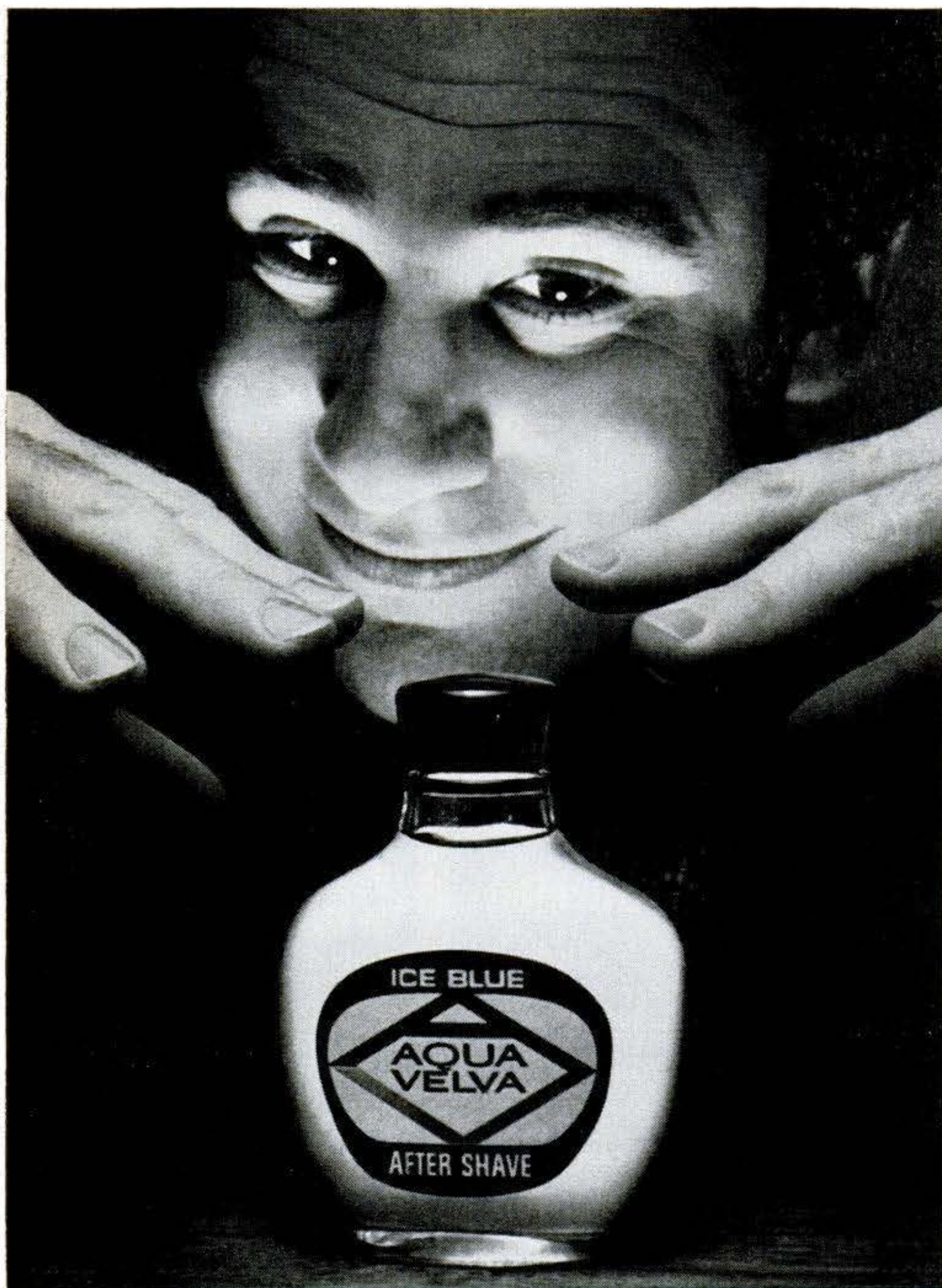


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"Say, Smokey—"

[Continued]

al return properly, although it required an excessive amount of pressure. I'd appreciate any help.

P. V. ROBERTS, Camarillo, Calif.

Your mistake happened when you put in the new clutch plate under that old, worn pressure plate. The new clutch disk was thicker and, when bolted up, the fingers retracted to an unusually low position, especially with all the wear in the pressure plate. Now that you have Mickey-Moused a fix, maybe you can get by. As you use the clutch, the lining will wear and the pedal will keep coming higher. Your only real fix is a new clutch plate.

Breaking in an engine

What is the proper way to break in a new engine? Is there a special break-in oil in new cars? If so how does it differ from regular oil? Do you recommend a special additive, and if you do at what percentage to the regular oil?

NORMAN FOLKER, West Allis, Wis.

As far as I'm concerned the answer to all of your questions is in the glove compartment of your car: that little book you've apparently never looked at. You're not alone, hardly anybody studies the owner's manual, and the engineers who designed your particular car spent nearly a year writing it! And they have to be by far the most knowledgeable on that particular subject. The oil you get in a new car is special for break-in and should be run and left in as the manual prescribes, with no additions or changes. Some dealers and car owners change the oil before the car ever starts out, mistake number one—the big one.

Wheel-balancing problem

My '70 Plymouth Satellite keeps breaking off the balance weights on its wheels. I run Sears 195R-14 radial tires. The clips break at the rim, leaving the clip tab between the rim and the tire. The wheel covers do not touch the weights and most driving is around town, with a maximum speed of 70 mph on turnpikes. Sears can't find the problem and say it's a "first" for them.

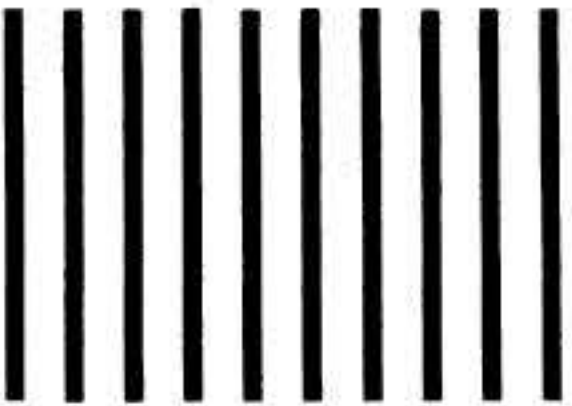
WILLIAM J. CLAYTON II,
Charlotte, N.C.

I think you simply have an incorrect wheel-weight application. That is, the edge and radius of your rims crack or stress the weights so much on application that they are ruined when installed. Or they could just be lousy weights. Seems like a lot of parts these days are going to hell quality-wise. What I'd do next is try stick-on weights. These are strips cut to weight, then held on with adhesive backing. That's what we use on race cars.

PS

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Let's talk about pollutants and car performance

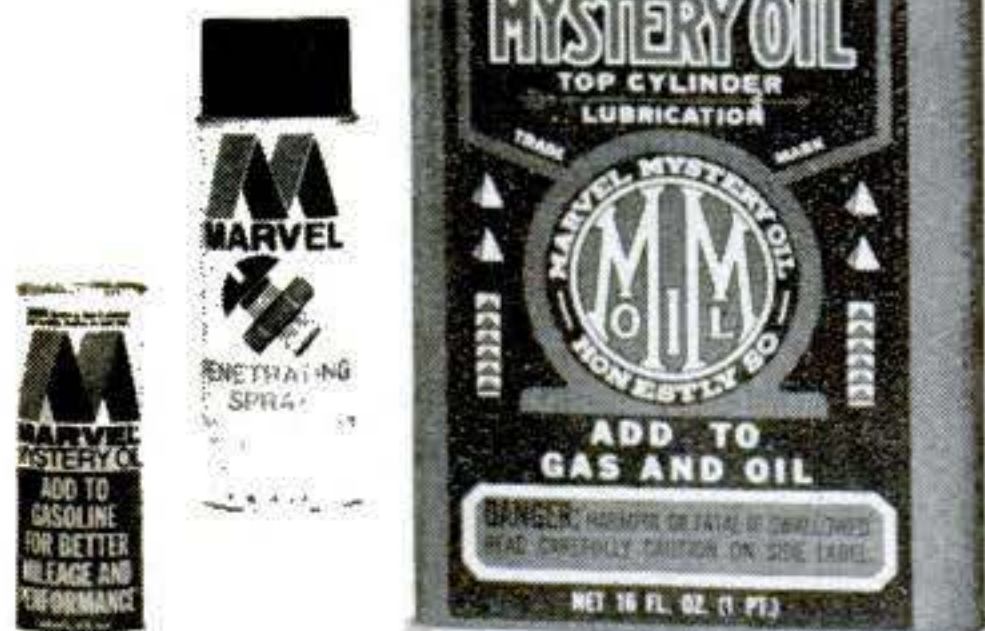


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Marvel Mystery Oil. More complete combustion. A cleaner engine. Longer plug life. Better performance. And more mpg. Test data on request.

Ask for other Marvel car care products too.

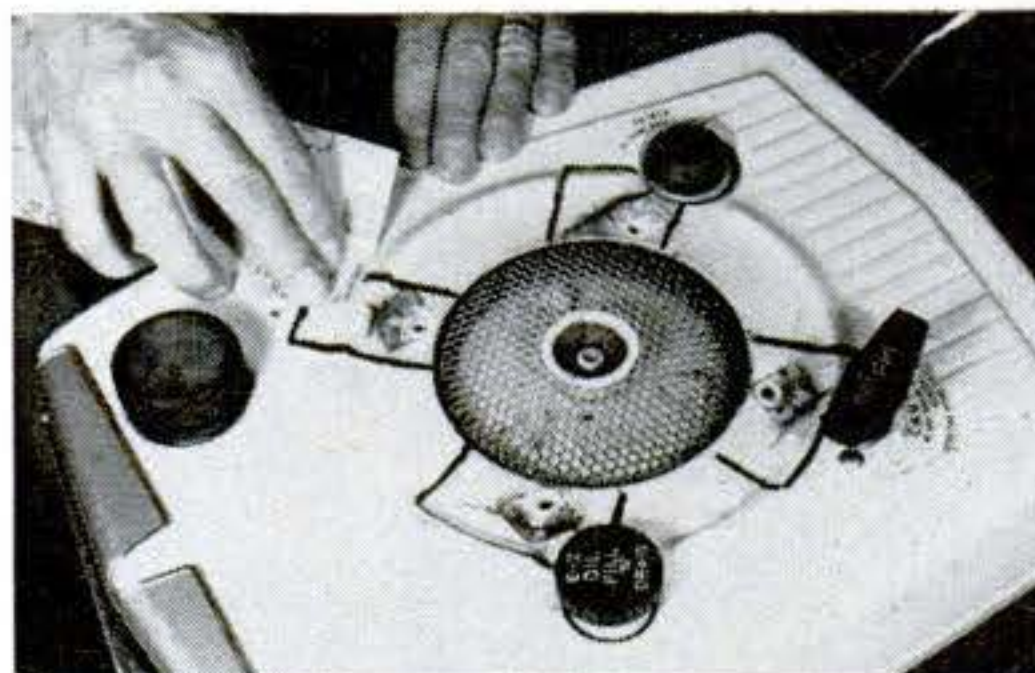


The "today" additive in a 50-year-old can.

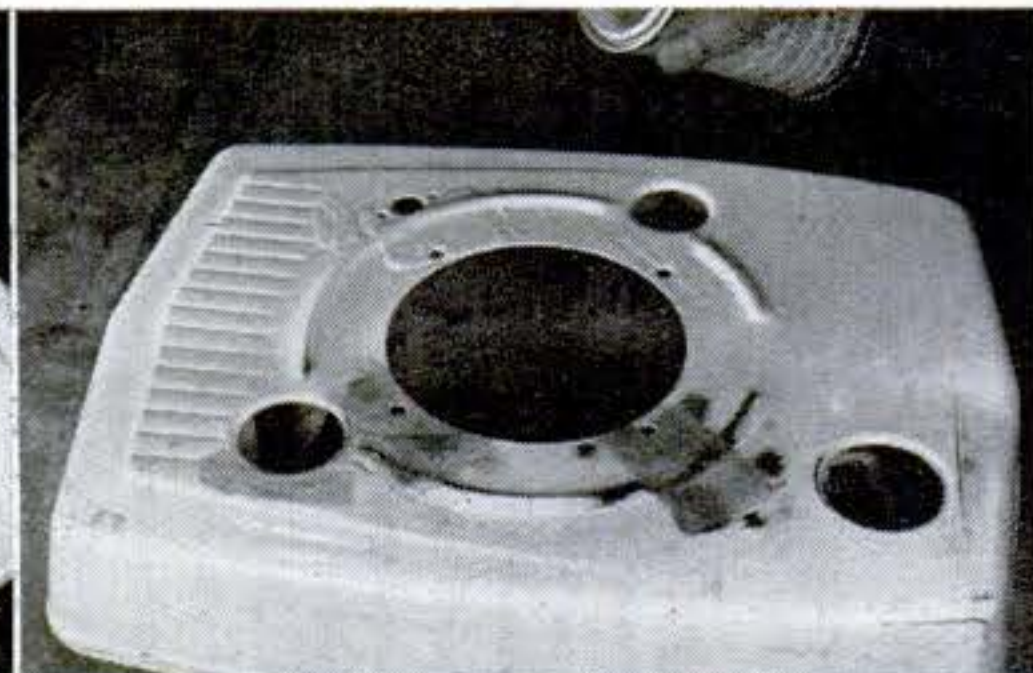
Marvel Oil Company, Inc.
Port Chester, N. Y. 10573

PERSONAL-USE REPORT

Patch Kit Works Like a Band-Aid



Cracked steel mower housing is easily mended with Sunset kit. First, sand away any paint or residue (above). Then cut out patch, strip off backing, and ap-



ply "bandage" to the clean surface (top, right), pressing patch firmly in place. When it's cured, sand and paint the repair (above, right).

Imagine a repair kit about the size of a road map that will fix—with minimum fuss and muss—a camper or snowmobile body, or a leaking boat, or even a broken fishing rod or gouged gas can.

3M's handy new fiberglass "bandage" will do all that, and can be used, too, for countless home, shop, and vehicle repairs. Their Sunset brand (for sun-set) repair kit is a masked 4-by-6-inch sheet of tough fiberglass cloth, presaturated with a resin that hardens when exposed to sunlight or artificial ultraviolet light sources.

The material is soft, pliable, and as sticky as flypaper in July; but when cured, it changes to a hard, tough surface and forms a strong bond. It can be sanded, drilled, punched, and painted. It's good for repairing or reinforcing wood, metal, glass, plastic, and fiberglass constructions.

One side of the repair sheet has a green mask you remove for application. A clear mask on the other side is removed after curing. Curing time depends on temperature and brightness of the sun. At 80 degrees in bright sun, it takes one to two hours. At 50 degrees in partly sunny weather, you should figure on eight to 24 hours.

The patch won't cure by sunlight through a window. And it may be obvious, but I had to learn by trying, on a wraparound fix you have to ro-

tate the object to expose the shaded side. Because of the masking that's left on (until cure), overlapping reinforcements must be made in two steps.

Regular heat, infrared, or grow lamps won't cure resin. It takes ultraviolet light—the kind emitted by most sunlamps and body tanning bulbs.

If repairs also require filling—as with a torn or dented fender, or a ground-away camper corner—resin putties can be used over the reinforcing patch. Be sure to sand the patch first, however.

The 3M Sunset repair kit sells for around \$1.19. If you can't get it locally (Sears stores carry it), you can order it by mail for \$1.50 ppd from 3M, Box 33981, St. Paul, Minn. 55133.—*Phil McCafferty*



Ultraviolet lamp does the curing. If painting is impractical, sand the patch with water and fine wet/dry paper.

Learn to be something you're not.

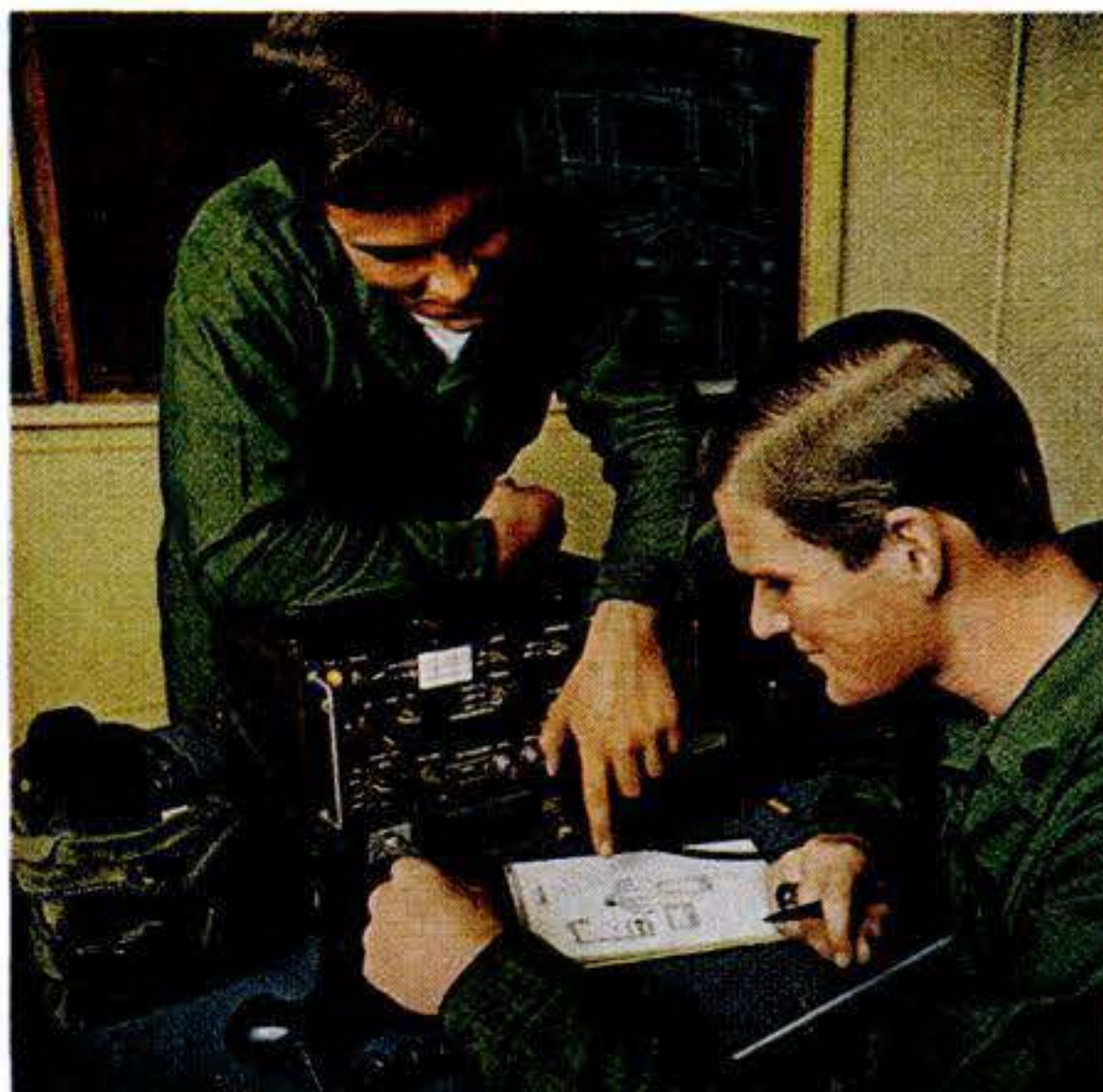
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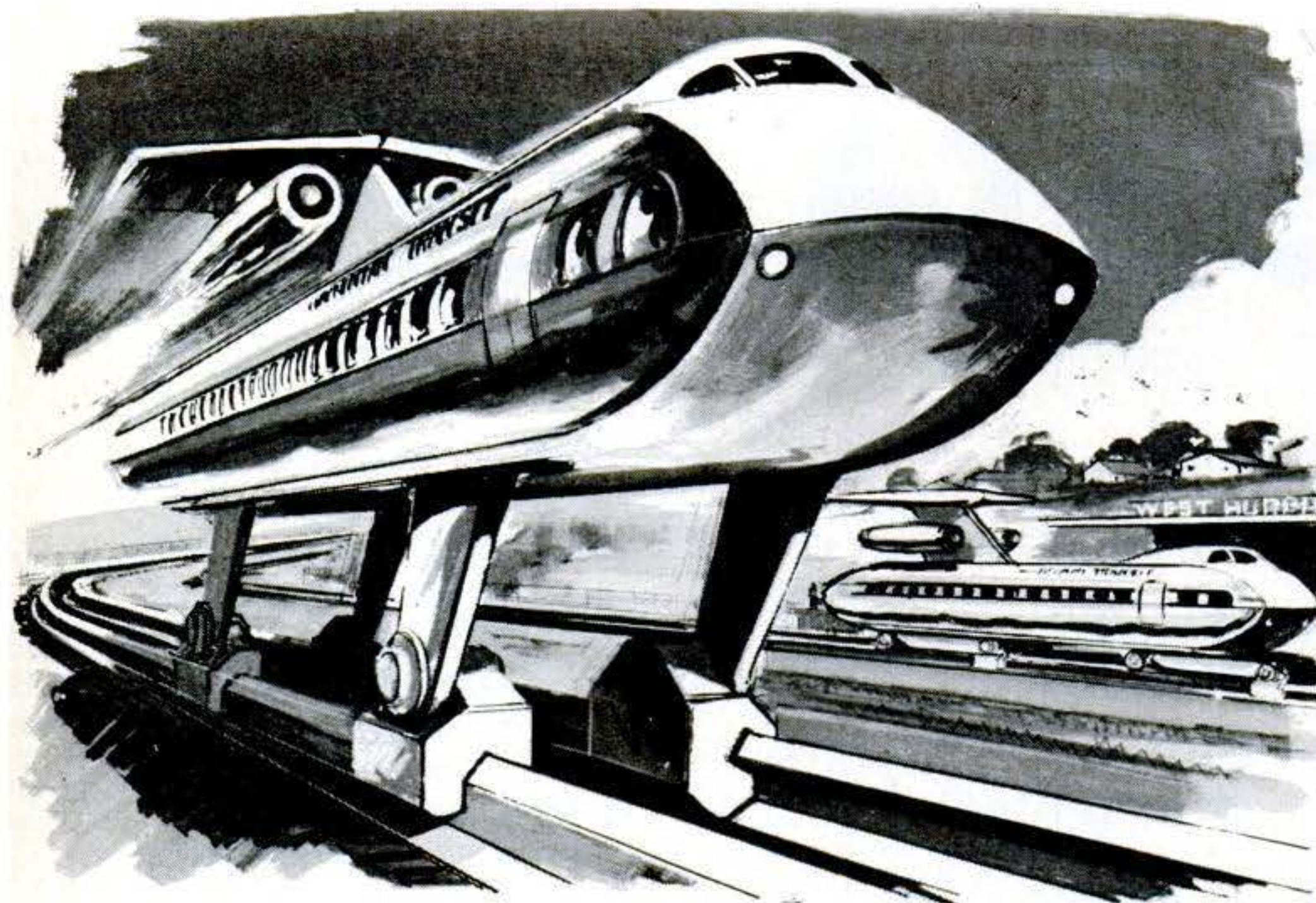
PS 9-73

**The Army Reserve.
It pays to go to meetings.**

New Ideas from the Inventors

The PS pick of ingenious inventions recently patented

ILLUSTRATIONS BY DANA RASMUSSEN



Pivot arms tether high-speed air-cushion vehicle

Linked to guiding rails by pivoted arms and by pads shaped to fit around track flanges, this jet-powered, plane-shaped ground vehicle would become airborne while traveling between stations at speeds said to range from 200 to 600 mph. Its inventor claims it improves on other types of air-cushion vehicles by utilizing—instead of counteracting—aerodynamic lift. Air streams from an on-board compressor would minimize friction between pads and rails; tethering reduces the amount of power needed to provide and control flight.

Jets dock and fender boat



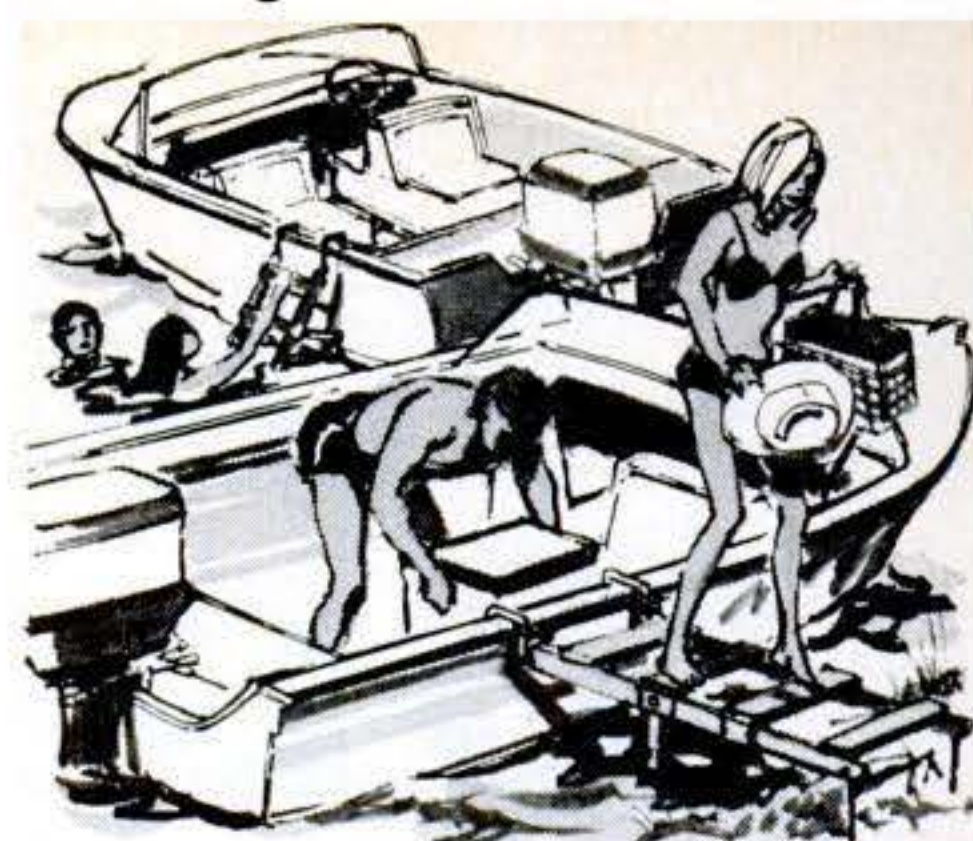
Adjustable for wind and water conditions, these underwater jets might permit quicker, safer docking at a berth or gas pier. Air or water pressure (or a mixture of both) would push the boat toward the dock while inboard jets fendered the vessel. The system could also keep boats clear of low-tide shoals or rocks at a harbor entrance.

Lawn trimmer pivots on sprinkler



Held on a lawn-sprinkler head by a simple screw attachment, this rotating cutter would quickly trim around—and right up to—the partly submerged fixture, a job that can't usually be done safely by ordinary mowers. You'd set the cutting height of the angled blade with a wingnut adjustment, then turn the trimmer by hand to shear the grass.

Boarding ladder moors boat

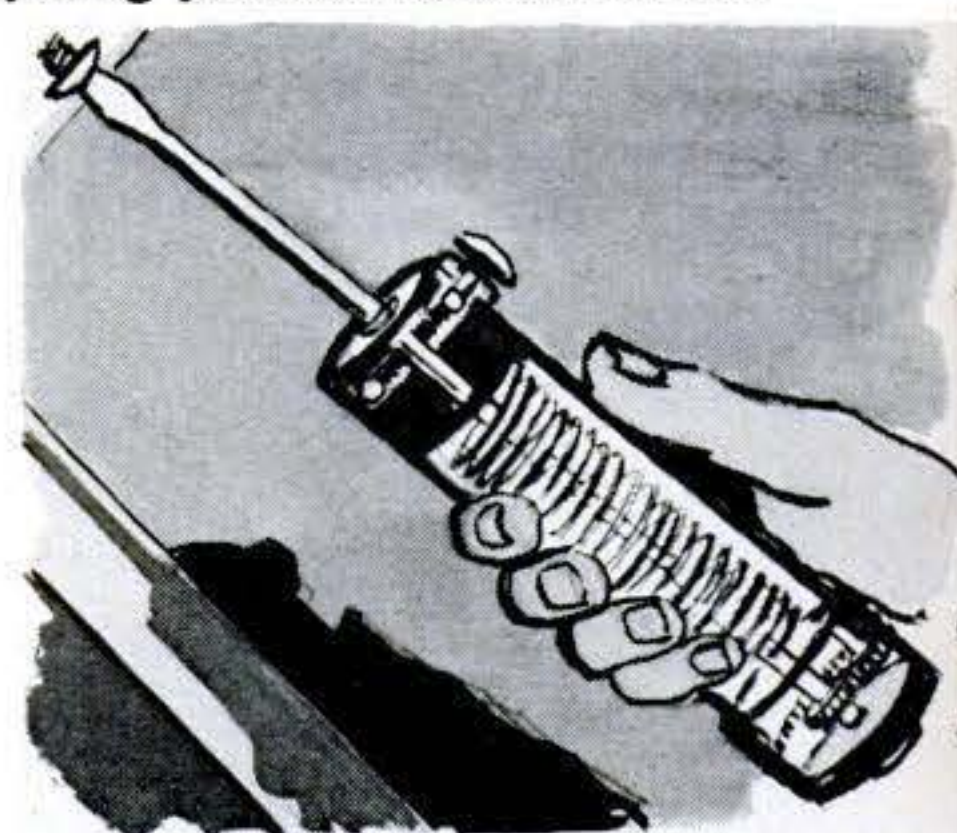


With U-shaped clamps at one end, pivoted spikes at the other, and adjustable legs in the middle, this telescoping ladder could be used either for climbing aboard a small boat or for forming a docking walkway to a sloping bank. The center legs would steady the ladder against the boat side.

Electronic counter charges tolls

Vehicles might move through highway toll stations more rapidly if drivers could charge their tolls electronically instead of paying cash. This new invention would use a billing counter and a transmitter—similar to a garage-door opener—carried in a car or truck. The vehicle's coded signal would lift a barrier gate and charge the passage against the user's prepaid deposit; alternatively, tolls may be billed.

Spring powers screw driver



The job of turning screws, nuts or other threaded fasteners might be eased—especially in hard-to-reach places—by this spring-powered driver. A lock-out mechanism would let you apply extra manual torque for starting or sinking screws. Pumping a push-pull gear and spring in the handle would rewind the drive spring.

The following patents have been issued on these inventions:

Jet train — No. 3,603,261 to W. Mann, Citrus Heights, Calif.; Boat fender — No. 3,585,802 to E. Frankel, Boston; Lawn trimmer — No. 3,589,008 to A. Ruiz, Los Angeles; Docking ladder — No. 3,571,836 to D. Dunlap, Redding, Calif.; Toll charger — No. 3,602,881 to R. Bayne and G. Haville, Santa Barbara, Calif.; Spring driver — No. 3,601,170 to P. Sciascia, Woburn, and S. Chin, Chelmsford, Mass.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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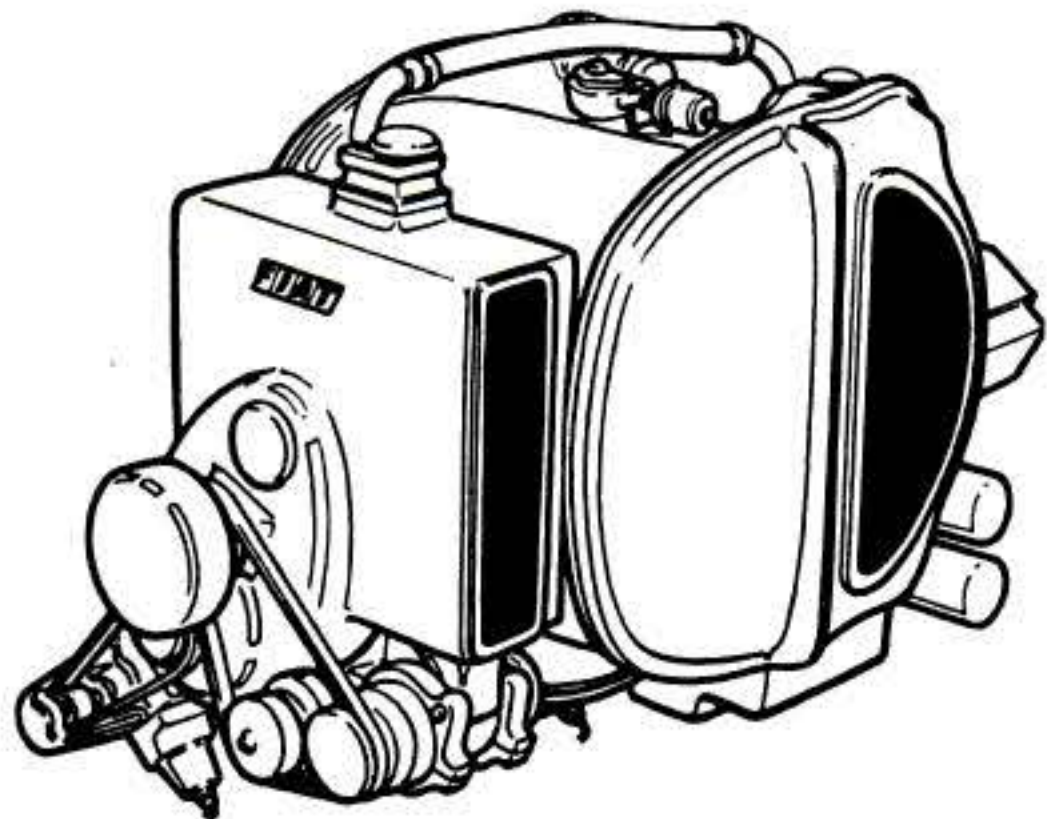


The View Down the Road

... news and comments on cars and driving

By JAN P. NORBYE / PS Automotive Editor

Fiat develops gas turbine for trucks



When I visited Torino, Italy, recently, Giovanni Savonuzzi, head of Fiat's gas-turbine program, told me a prototype truck turbine is already on the road. Other versions will follow (railroad, marine, tractors, off-road vehicles). A passenger-car turbine can be expected in two-three years. Fiat built a 300-hp turbine car in 1954, but has concentrated on trucks in recent years.

The engine resembles the Chrysler turbine [page 56]. It's a two-shaft design with a free power turbine, using two rotary heat exchangers. The centrifugal compressor has a

pressure ratio of 4:1, and peak power (400 hp) is developed at 33,000 compressor-shaft rpm. Specific fuel consumption is 0.46 pounds per hp-hour. The program provides for up and down scaling of the basic turbine as high as 1000 and as low as 100 hp. The 400-hp truck turbine weighs 1540 pounds and drives via an Allison automatic transmission.

Fiat already has installation plans for turbines in some production-model passenger cars, right down to the little front-wheel-drive 128. Vittorio Montanari, Fiat's chief of applied research, showed calculations that the smallest turbine would add 33 percent to the cost of the 128 sedan, increase its weight nine percent, its length 6.5 percent. Thus, you can easily guess that Fiat's next turbine cars will be based on the bigger and costlier models—the V6 Type 130, say, or rumored Type 136. Fiat 130 is a 3.2-liter model in the Mercedes-Benz class, and the 136 can be expected to fill the gap between the 130 and the two-liter 132 (a family car in the Volvo class).

No new boss at the NHTSA

It's now nine months since Doug Toms said he was leaving his post as administrator of the National Highway Traffic Safety Administra-

tion, and his successor has not yet been named. If you think we can get along just fine without one, let me tell you what I learned in Europe when I lunched with Rudy Mailander, assistant to Dr. Gianni Ag-

nelli, chairman of the board at Fiat. Rudy had been to Japan for the ESV conference in Kyoto, and he said that at the end of the presentations by the participating auto makers, the NHTSA representatives did not deliver their own prepared paper. They thanked everybody for coming—and went home, leaving the ESV program in limbo.

World looks to U.S. to lead

Progress on auto safety is of vital concern to every auto maker in the world, and most of them would like to see uniform world-wide standards. But they must come from the U.S., Mailander explained: "If the U.S. won't set the rules, the Germans will go one way, and the French another, and we'll try our own approach, too. We need DoT as a central regulating agency for auto safety."

It seems to me America not only has a responsibility here, but also a great opportunity to spur safety research on a broad base, and to obtain the necessary knowhow to set realistic and cost-effective standards.

Stratified-charge Fiat engines

With a production capacity of almost two million cars a year, Fiat would have enormous problems in retooling for any alternate power plant. It intends to continue piston-engine production for the next decade, with whatever modifications are necessary. Right now, it looks like stratified charge is the way to go, technical director Oscar Montabone told me. Fiat engineers are working on three types of stratified-charge systems, one with carburetors and two with fuel injection, all simpler and more efficient than the Honda CVCC [PS, Apr.]. The Fiat experimental engines have pre-combustion chambers but not the extra valve used on the CVCC. Fiat controls the combustion process by internal aerodynamics, using supersonic turbulence patterns.

Revolutionary experimental tire from Pirelli promises more safety and lower cost

Just 80 miles east of Torino is Milano, Italy's commercial center and home of Pirelli tires. A team of Pirelli technicians led by Ing. Tangora has been working for three years on a new concept in tire construction, and I was able to get some details of the new tire.

In a normal tire, the sidewalls are held in tension by the air pressure inside. On the new tire, the load (weight of the car) is utilized to keep the sidewalls in compression (drawings). Is it better? If it works, it has a lot to offer:

- 1) Lower risk of blowout (due to thick rubber sidewall).
- 2) Lower risk of sidewall damage.
- 3) Run-flat capability.
- 4) Higher mass-production uniformity due to elimination of cord

plies and cord overlap (carcass is rubber only, with a belt).

5) Better cornering stability due to lower profile.

6) Opportunity for bigger brakes, due to larger wheel for any given tire size.

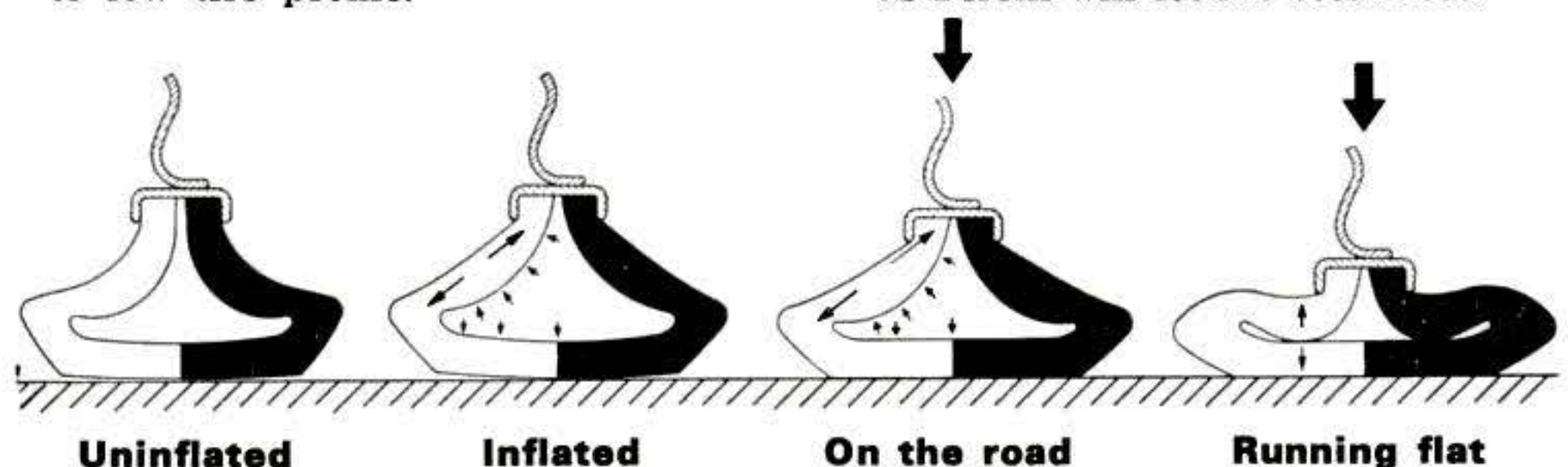
7) Opportunity for lower center of gravity in the entire vehicle, due to low tire profile.

8) Chance of cost cutting due to simplicity (fewer components.)

9) Possible automated production.

10) Twenty percent lower O-E tire and wheel cost per car due to elimination of the spare wheel.

I'll bring you the full story on this revolutionary new tire as soon as Pirelli will let me test a set.



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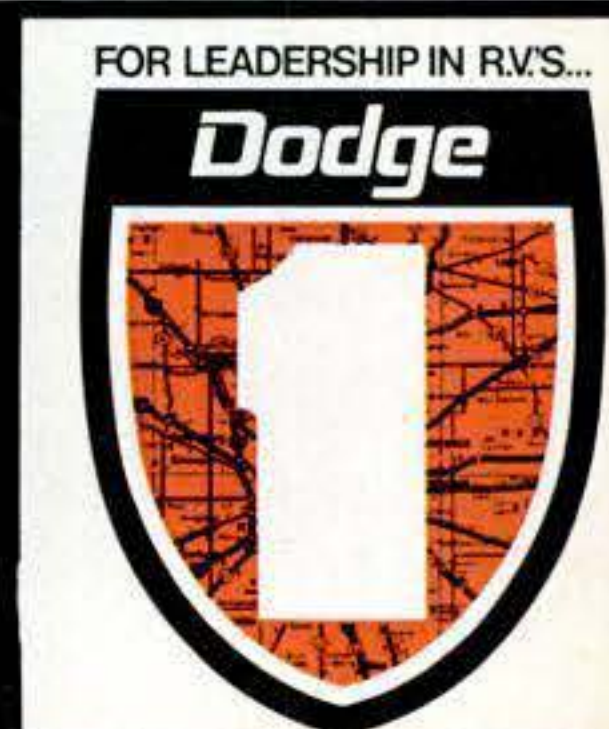
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Description	Discount (From base premium)
Multi-car Ownership	15%
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Good Student	25%
Bumper (Meets Federal Safety Standards)	10%**

Of course, it's also important to consider the basic rate or premium upon which the discount is being given. Today insurance companies don't all charge the same rates. In fact, no one company can say it has the lowest rates overall. Because each bases its rates on its actual experience with specific classes of drivers and specific geographical areas. The result: You may find that in your area Continental's price for you is lower than either Allstate's or State Farm's. Or both.



The Independent Agent. He doesn't work for an insurance company. He works for you. And his success is based on placing your insurance with whatever company will keep you the happiest. If we don't do the job, he's free to switch your insurance to a company that will.



Choice of Plans. Continental gives you a choice: A policy that covers your car alone. Or a unique new policy that covers both your car and home. It's called Personal Comprehensive Protection: PCP*. By combining both your



automobile and homeowners policies into one, it can actually give you more insurance coverage for your insurance dollar.



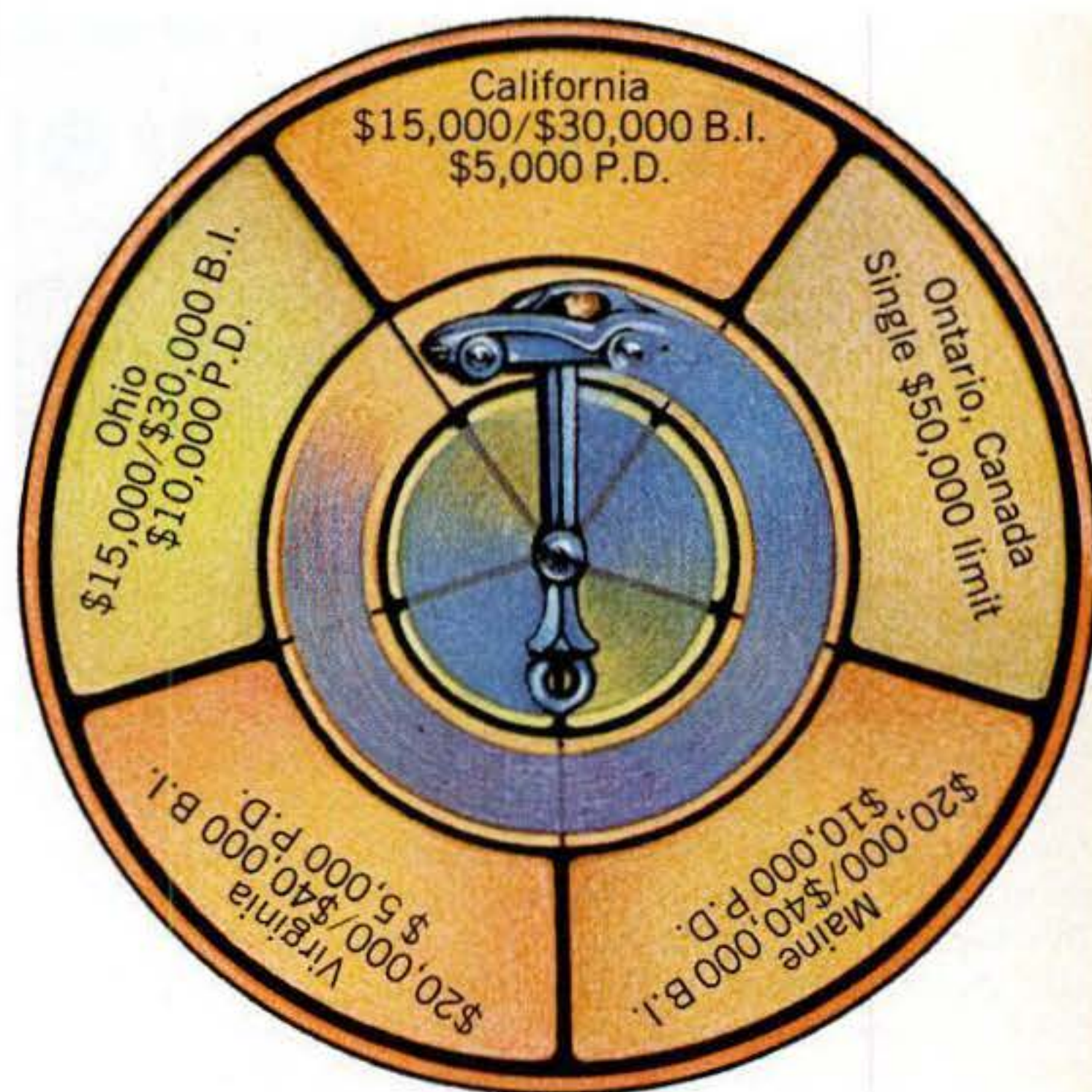
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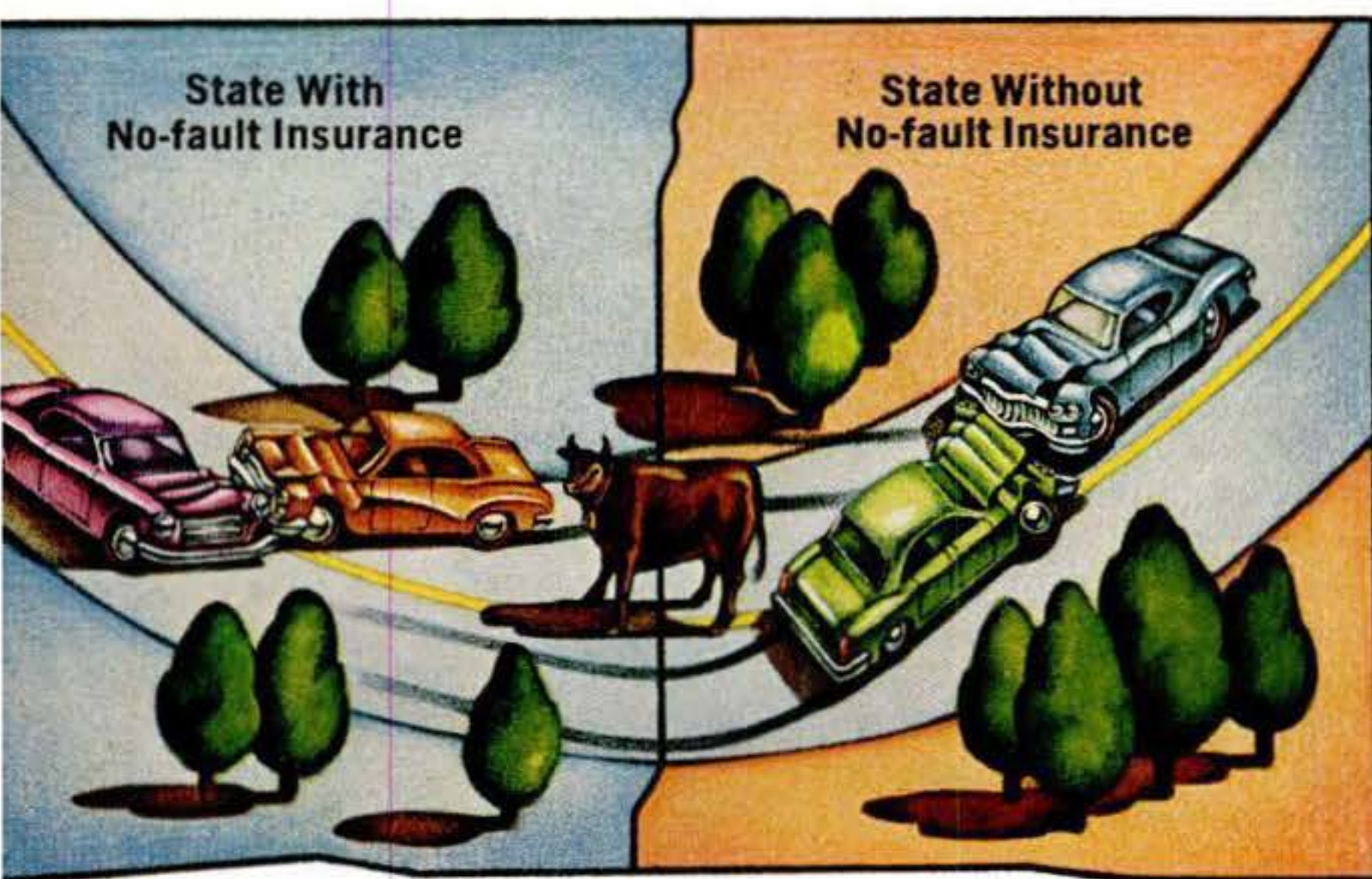


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From the U. S. Patent Office...

A New Program to Protect Your Invention

**Got a wonderful idea for a new what's-it?
There's a little-known way to safeguard
it that's cheap, simple, and foolproof**

By GARY A. YONAITES

Strange as it may seem, the easiest step for a novice inventor is the invention itself. The average inventor has been dealing with material familiar to him while working on his creation. Even though he may face thorny technical problems, he is usually expert enough in his particular field to overcome them.

When he has enough of the bugs ironed out to know his idea is workable, however, he enters foreign soil. Whom should he show it to? How can he protect it from greedy hands? What steps should he take to establish his claim as inventor?

Patent fact and fancy

The road to protecting an invention is paved with half-truths and hearsay. It seems everybody I talk to has an uncle or friend who supposedly invented something only to be beaten out of it by some sharp hustler. I run across people every day who talk as if they wrote the book on patent protection, but actually know almost nothing in the way of fact. Unfortunately, they include many who are supposedly in the business of serving the inventor.

I am not, of course, speaking of registered patent attorneys and agents, but of the many pseudo-professionals springing up across the land under the label "Inventor's Services" and the like. Some of the companies in this field are quite honest and do a good job for the inventor, but many are rank amateurs at best and slick hustlers at worst.

People in the know

For this reason, I strongly suggest that the inventor take the first step in protecting his invention before disclosing it to *any* outsider. The

only people who should know about an unprotected invention are the inventor and, possibly, two trustworthy friends to witness the disclosure. The only other exception: a patent attorney, if one is being consulted at this preliminary stage.

Until recently, an inventor's first step toward protection was to prepare illustrations and a description of his invention, have these witnessed and notarized, then send them by registered mail to himself or his attorney. By leaving the envelope unopened, he was able to prove that he had indeed invented the device sometime before the date of postmark. This date is known as the "date of conception."

Although this method offered some proof as to when the invention was conceived, it was far from satisfactory. Let us suppose that three or four months after the original disclosure, the inventor substantially improves or simplifies his device. What would prevent him from steaming open the envelope and adding this new material? After the envelope was resealed, he could claim that the original disclosure contained this more recently developed material.

The possibility of such tricky business always exists, and it casts serious doubt on the entire method. The procedure is still recommended, even with its evident shortcomings, but now only as a supplement to another, far more reliable one.

New Patent Office program

On April 17, 1969, the U.S. Patent Office inaugurated a new program to solve this long-standing problem. Unknown to most inventors, the Patent Office now offers a service that provides ironclad proof of a "date of conception." It is known as the

"Disclosure Document Program" and is the essence of simplicity both in concept and execution.

An inventor need only send his disclosure to the Patent Office with a request that it be accepted under the program, and they will retain it in strict confidence for two years, or until a patent application is filed. After the two years, the disclosure will automatically be destroyed. What is the cost of this service? A modest \$10—probably the best bargain for an inventor today.

According to Isaac Fleischmann, Director of the Office of Information Services in the U.S. Patent Office, only 13,160 disclosures have been made through this program in the first three years it has been in operation. Yet there are more than 100,000 patent applications filed each year; it is amazing that such a beneficial and economical program is so little used.

The reason for this seeming lack of interest is, in fact, a general ignorance of the program's existence. To quote Mr. Fleischmann, "Too little is known about the program. It would be helpful to take advantage of every opportunity to inform people that this program is available."

A big bonus

Since the Disclosure Document is filed in the Patent Office, the inventor has the additional benefit of having this document referred to in any subsequent patent application. This could save considerable anguish and inconvenience should the inventor become involved in an interference proceeding, in which someone else applies for a patent on the same invention. Only one percent of patent applications ever become involved in such a proceeding, but that's more than a thousand a year.

It is also important to remember the two-year period the Patent Office will retain the disclosure. During this time, the inventor can try to perfect and improve his invention until he is satisfied it is ready to be patented.

One point most inventors overlook is that once a patent application is filed, no new improvements may be added. This means that if an application is filed before the invention is fully developed, any changes or improvements over the original must be covered by a new and separate application. This is a very common mistake, and a very expensive one.

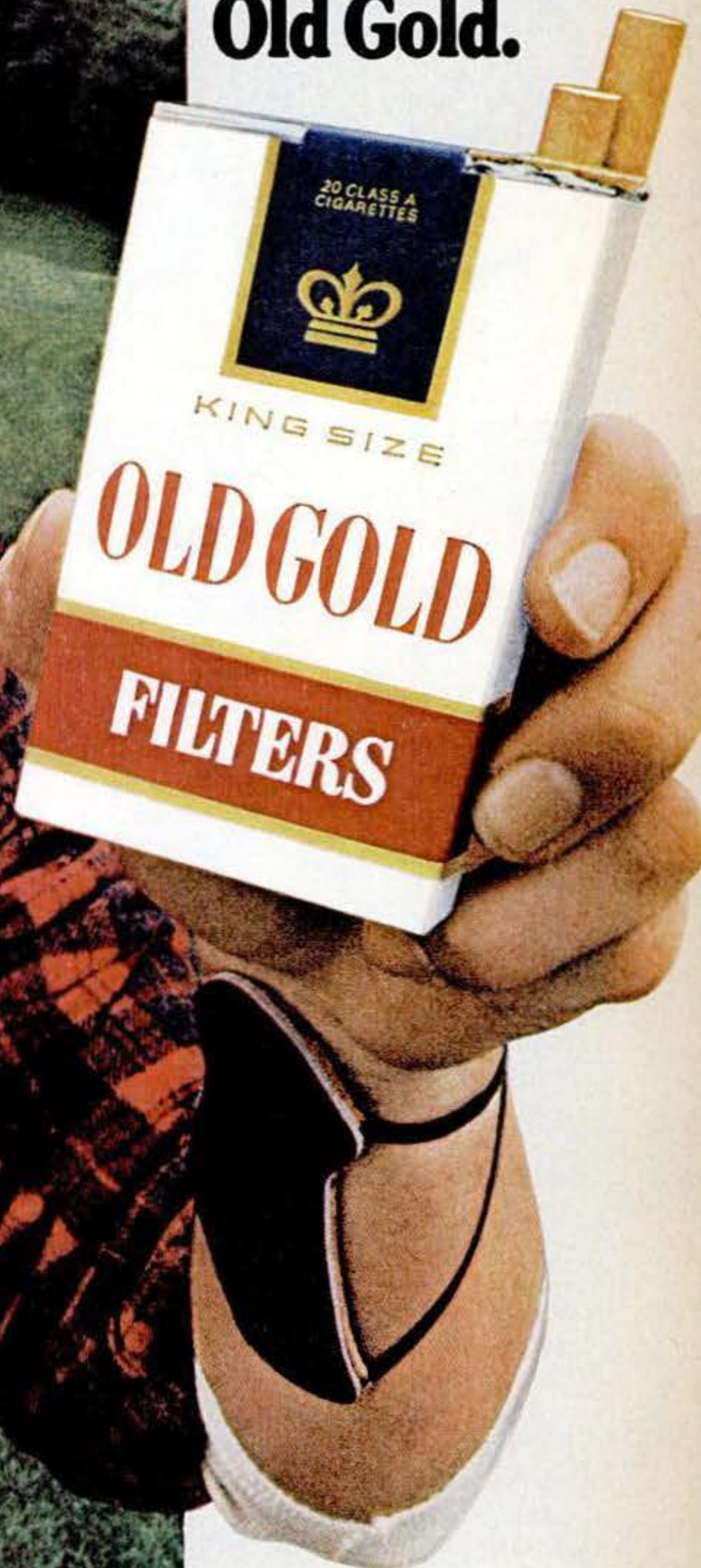
With the Disclosure Document Program, an inventor can wait until he is reasonably certain that his invention is perfected before filing. This

[\[Continued on page 126\]](#)

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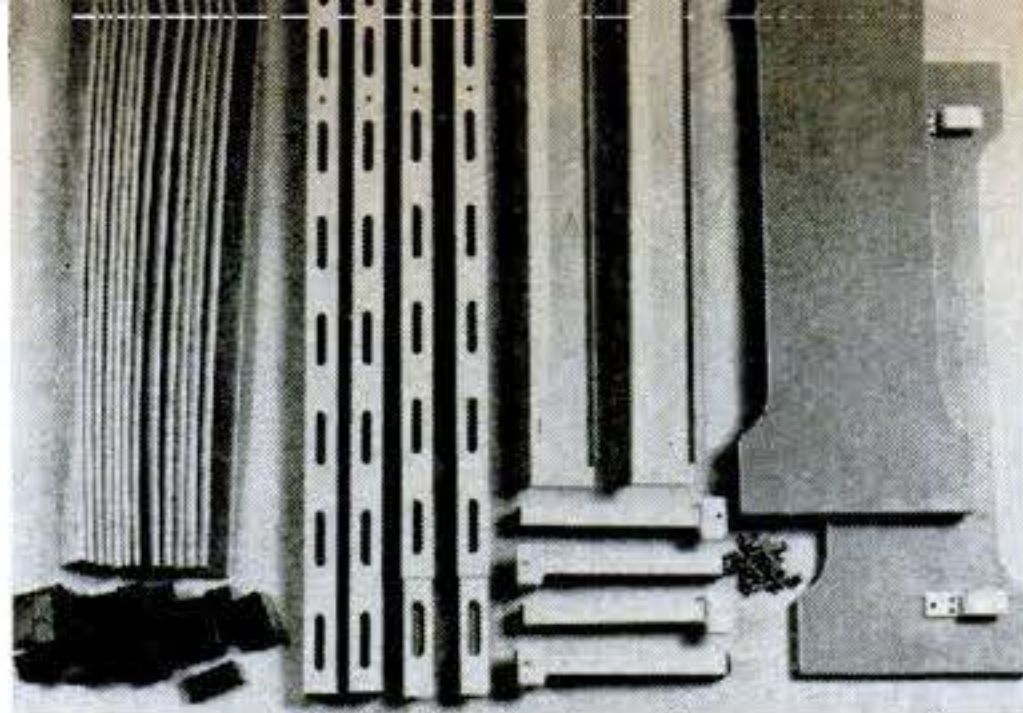
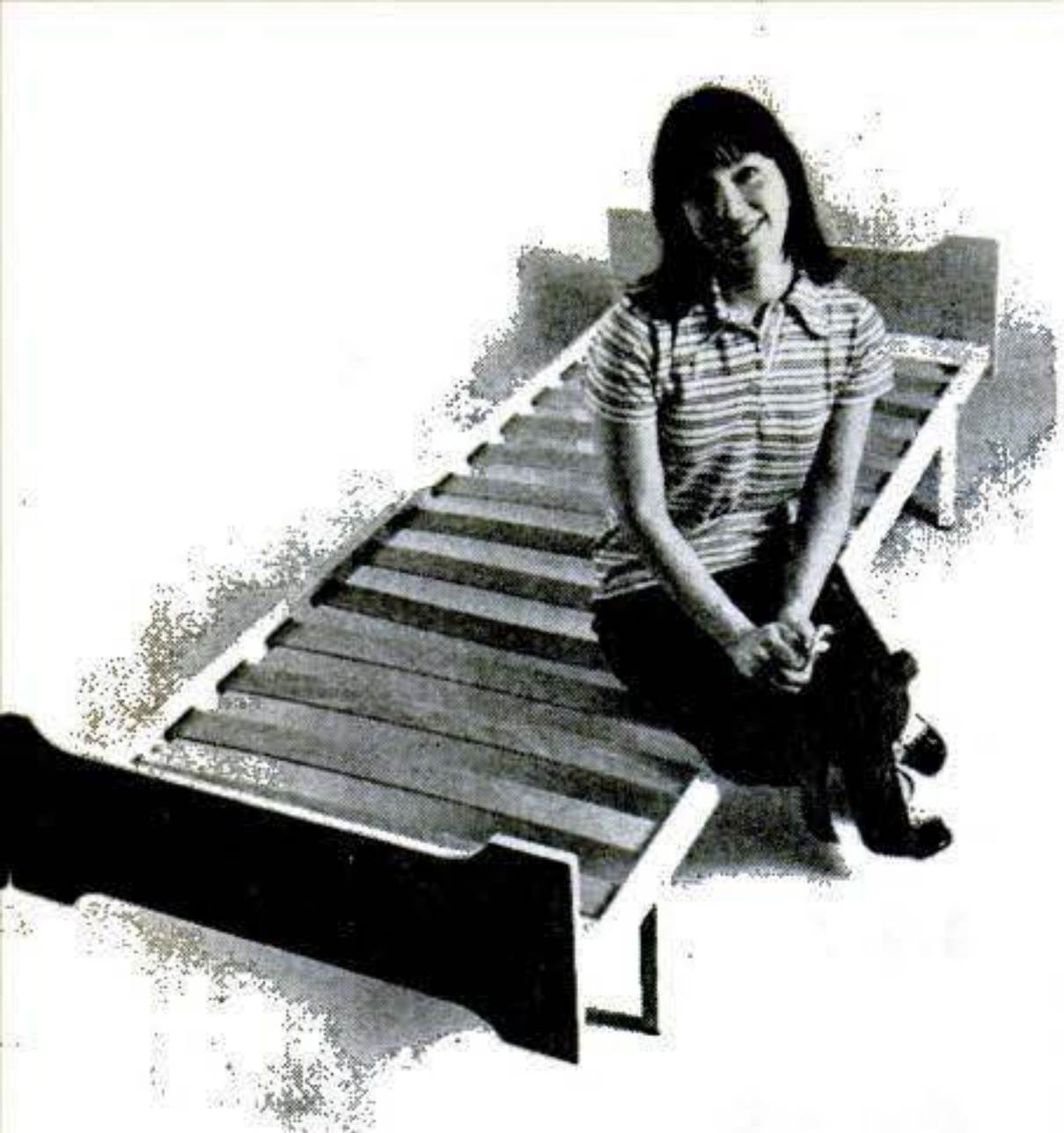
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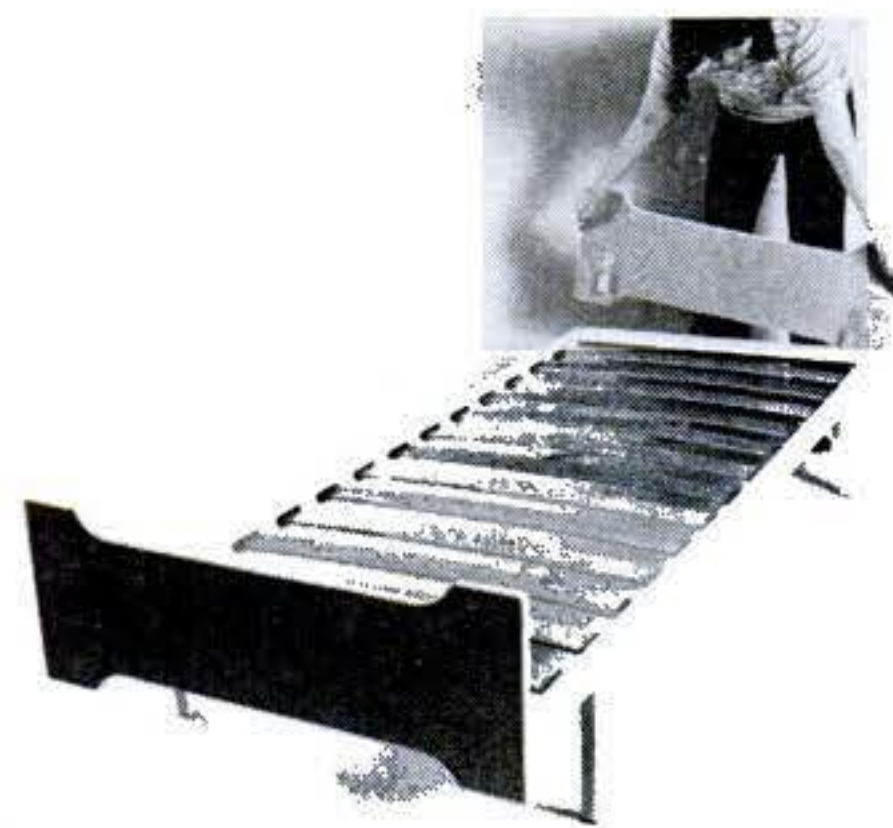
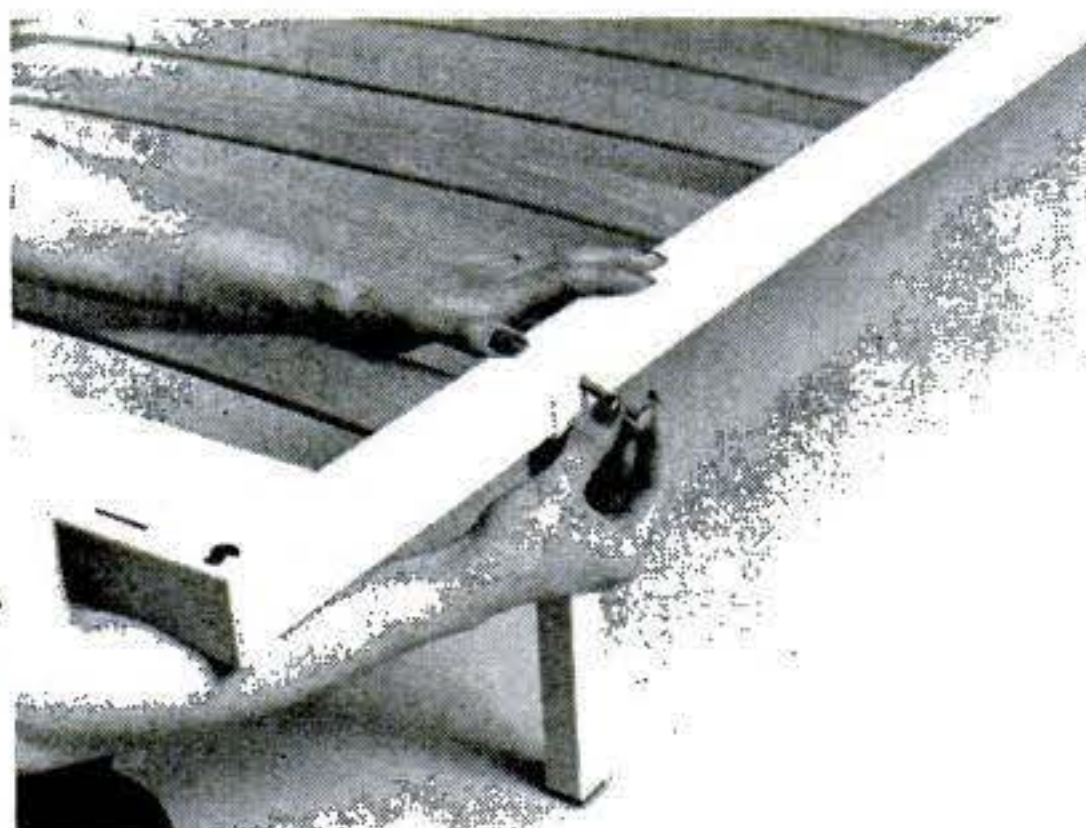
PERSONAL-USE REPORT

Quick Kit Cot Hides in Your Closet

Unexpected guest? You're all set if you have a Selfrest bed hidden away. It comes in a kit, as shown at left, with a foam mattress. All you need is a wrench and 20 minutes to put it together. Frame is steel; slats are wood and act as springs.

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The Selfrest bed comes in two sizes—30 by 75 in. (\$69.95) and 36 by 75 in. (\$79.95)—from International Merchandise Corp., Box 1071, Worcester, Mass. 01613. Prices f.o.b. Worcester. —Marilyn H. Bender



"How I rewired my taillights with a plastic straw and Dow Corning Bathtub Caulk."

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"When my taillights started getting dimmer and dimmer, I took them apart and found that the sockets, wires, everything, were all corroded.

"So I cleaned everything up, bought two new sockets, and decided this time that they weren't going to corrode.

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almost any fix-it job around the house, get the Dow Corning Silicone Bathtub Caulk out of the bathroom and put it to work.

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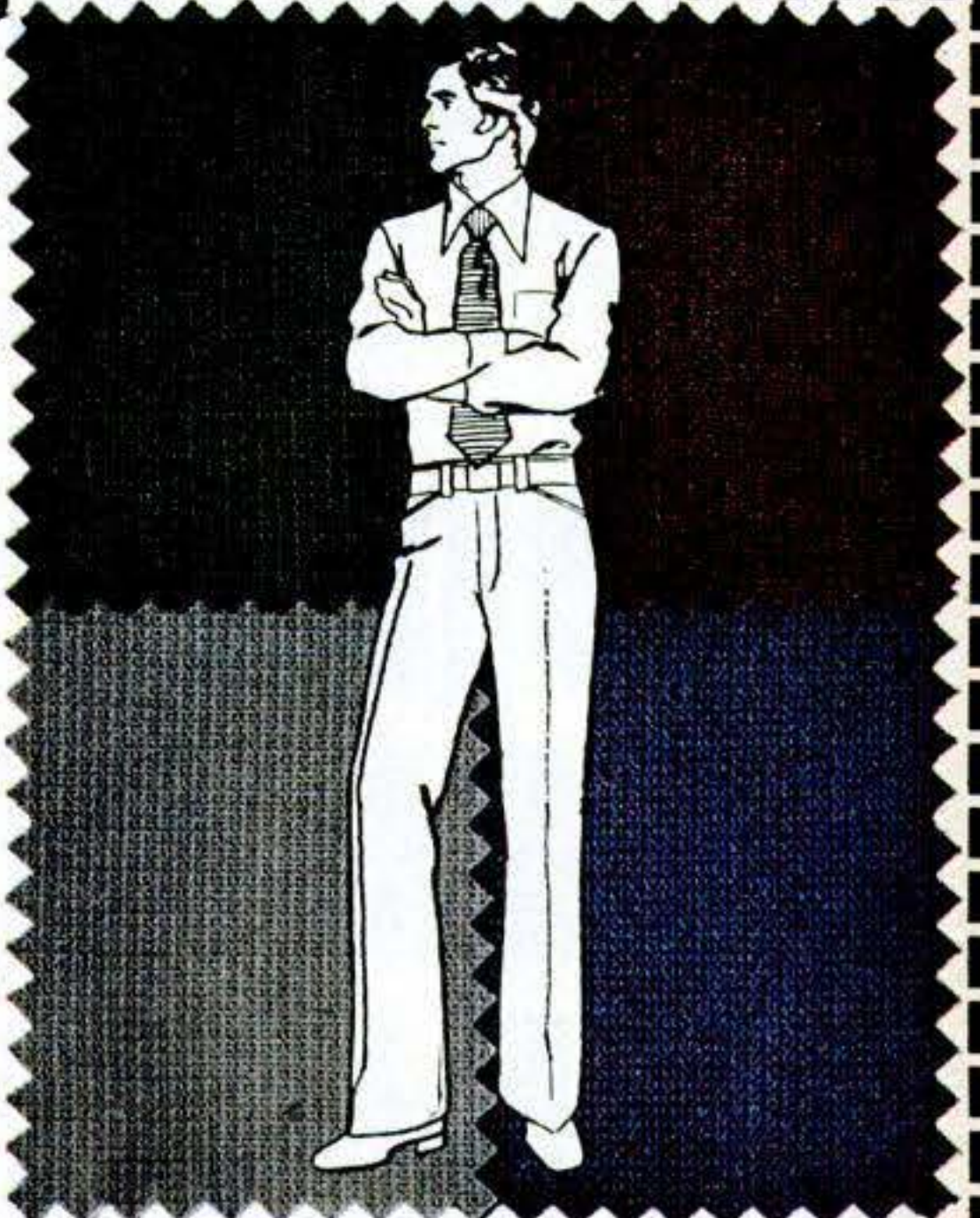
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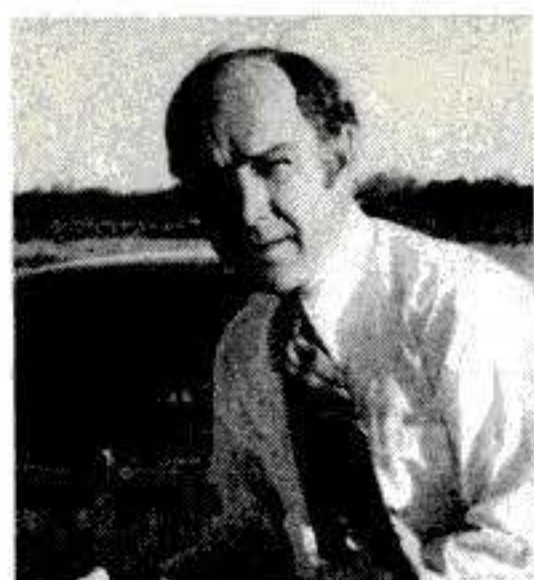
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Detroit Report

Behind the scenes in the auto industry

By JIM DUNNE / PS Detroit Editor

Future cars will be smaller

You have heard that before. But few people realize just how small Detroit is thinking right now. One company believes that full-size cars of the mid-1980s will be smaller than today's intermediates. What this means is that the traditional six-passenger car will be abandoned. Four-seaters will become the new norm. Bodies will become narrower, lighter, and allow the use of smaller and lighter engines with lower fuel consumption. Some observers feel there is still a place for the full-size car as we now know it, but few of these cars will be built 10 years from now. Another change in store: High-priced luxury sedans will come in all the smaller sizes.

A czar for auto rules?

Detroit wants federal standards regulating cars to come under one central authority, instead of the several agencies now writing out regulations. The problem is that the present EPA and DoT standards work against each other. Standards for reduced emissions conflict with proposed standards for fuel economy. In a similar way, standards for bumpers and occupant protection hamper the achievement of small, lightweight cars that will burn less fuel. It has been suggested that all performance standards (brakes, emissions, engine performance, fuel economy, and safety) be combined so they can be solved concurrently.

The boom in vans and pickups

One thing that's happened to the truck market is that more families are buying light trucks as second and third vehicles for the household. Sales are booming. Buyers are looking for variety in their vehicles; want to own different types that will perform more tasks. Chrysler VP Bob McCurry, who sometimes has five different vehicles at home at one time, says of his family: "We use them all, and I don't see any limit on the variety we can use." That's the experience with buyers too. With two or three members of the family driving, the preferences in models are divergent. Trucks are a natural part of this scene. They take care of tough work tasks and make fine leisure-time vehicles.

GM's turbine-car program lives

The latest version of GM's passenger-car turbine is called the GT-225 and is running in a 1973 Impala. It was developed by Al Bell, who for years was one of Chrysler's key experts. The main news in the GT-225 is the low-NO_x combustor—twice the size of the GT-305 combustor. As for GM's truck turbine, Allison is ready to build it, but GMC (and Chevy) aren't ready to build turbine trucks. Ford may beat them to it!

Puzzle at Chrysler: what engine for the subcompact?

One of the big decisions holding up Chrysler's plan to introduce a domestically manufactured subcompact in 1976 is what type of engine to use in this car. Right now the company's smallest auto engine is the 198 cubic-inch six, and that's just too cumbersome to install in a car with the exterior dimensions of the Pinto and Vega. Chrysler has studied all kinds of alternatives—including a rotary (Wankel) engine, and a new smaller six, as well as half-a-V8 four-banger such as the little engine Pontiac originally used in the Tempest (1961). Imported power units seem to be out of the question (Chrysler makes modern four-cylinder engines in both England and France) now that the dollar buys less overseas. Insiders think Chrysler will soon commit itself to building a new four-cylinder engine factory in the U.S. This will cost more, and the engine will be too small to use in Valiants or Darts. But Chrysler needs the subcompact as soon as possible—it's now slated to be a '77 model.

Wankel power for AMC Amigo

American Motors Corporation's plans to introduce a Wankel-engine car, code-named Amigo, in 1975, are moving ahead. The vehicle is an all-new design that can be expected to replace the Gremlin. The proposed Amigo \$3000-plus four-seater will look quite similar to the Hornet GT show car unveiled earlier this year. At first, AMC will equip the car with a conventional six-cylinder engine, later will use a purchased Wankel. AMC is now testing prototype cars with Mazda and Comotor rotaries. When the GM rotary engine goes into production, AMC will test and evaluate that also.

As it stands today, AMC is leaning towards the GM engine, considered a more advanced version of the highly sophisticated Mazda design.

GM Wankels for the F-body cars

The Fisher F-body is used for the sporty compacts from Chevrolet and Pontiac (Camaro and Firebird). GM has now decided that the all-new models due in 1976 will be the next vehicles after the 1975 Vega to be equipped with the rotary engine. At the same time, Camaro and Firebird will switch to front-wheel drive. The twin-rotor engine will be mounted ahead of the front-wheel axis, with the transmission split by the final drive unit so that the torque converter is mounted on the rear end of the crankshaft, but the planetary gearing will be enclosed in a casing extending backward from the final drive. An optional five-speed manual transmission will also be offered on these cars. Body and chassis will be adapted from the Vega.

The plan is highly significant. It means that the sporty cars will be

the first high-volume vehicles to obtain the GMRE. How many will be built in a year? Perhaps as many as 300,000. Next, GM will have to decide, based on this experience, whether to redesign the X-body (compact cars: Nova, Ventura, Omega, Apollo) for Wankel engines.

Dodge to launch 4x4 utility

A new four-wheel-drive Dodge will be introduced mid-year 1974. Code-named the Rhino, the new vehicle is based on the Dodge D-100 pickup truck chassis and sheet metal. In size and shape it is similar to Chevy's Blazer (and Jeep's new Cherokee), and is part of Dodge's plan to deepen its thrust into the booming light-truck market. The four-passenger Rhino will offer full-time four-wheel drive (using the system made by Chrysler's New Process Division, which Chevy chose for the Blazer).

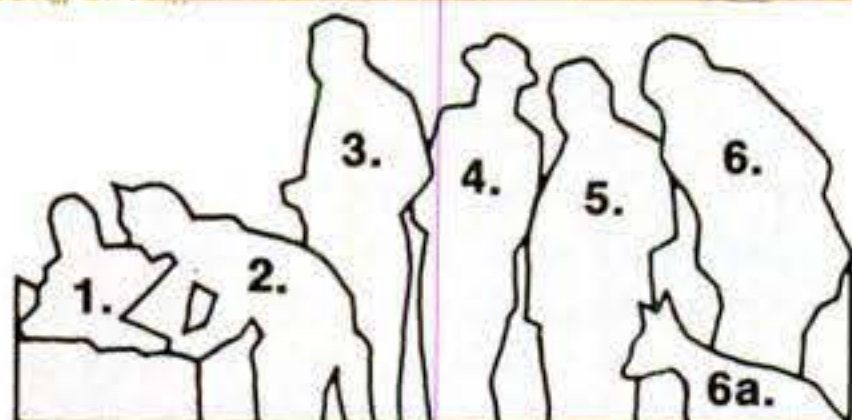
Bigger wheels are coming

Reports are that GM is asking Akron tire makers about the chances of producing 16-inch tires for the 1975 model year. If good, GM will put the big wheels on its full-size station wagons next year. Why the switch? Because better brakes are needed. In 1975 Federal standards for brake performance will call for shorter stopping distances, and the brake experts are clamoring for more space inside the wheels to get room for the bigger brakes to do the job. Today, the biggest OE tires are for 15-inch rims. There are indications that smaller cars will push into that size. The 1974 Chevelle Laguna, an intermediate (A-body) car, will use 15-inch rims (14-inch rims are normal for intermediates).

Can you spot the Camel Filters smoker?



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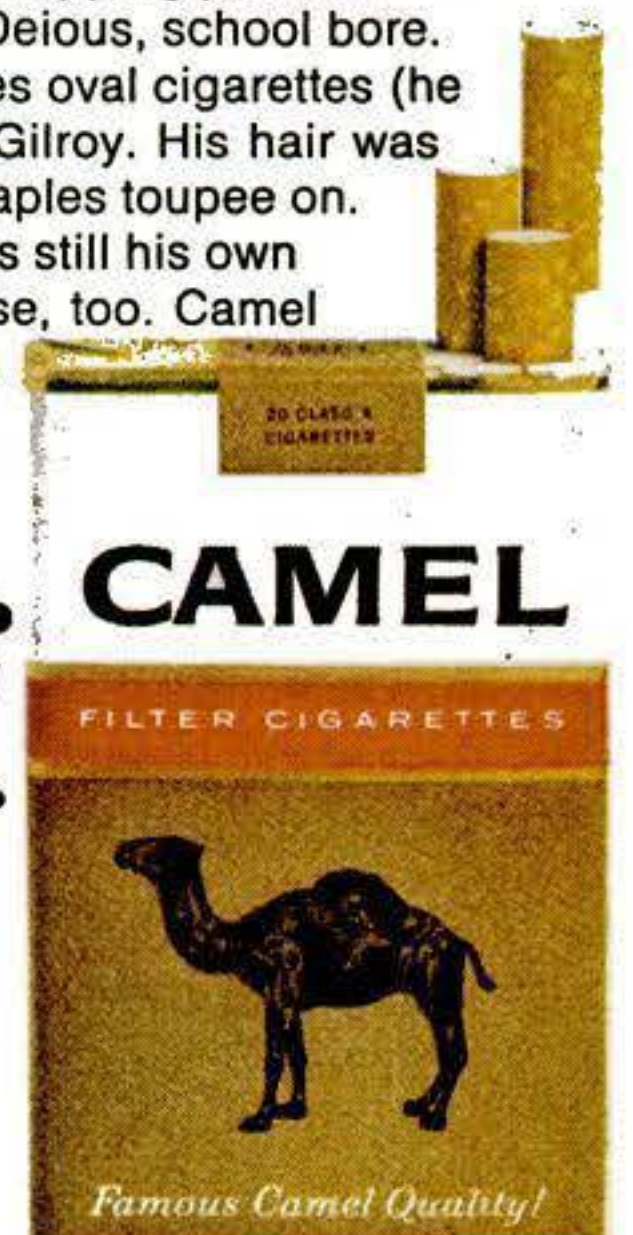


At class reunions almost everybody has a gimmick. Try picking the one who doesn't go along.

1. Nope. He's Don Wand. Won school essay contest with "The Art of Pre-Marital Dancing." Gimmick: 200 mm holder to balance his 100 mm cigarette.
2. No. It's Rah-Rah Mendelson, ex-cheerleader. Gimmick: He's wearing it. Smokes whatever he finds in his pouch. 3. No.

He's Moe Mentum, alias "Stone Hands" for dropping passes. Just dropped statue of school mascot. 4. T. Deious, school bore. Gimmick: His voice, off-key contralto. Smokes oval cigarettes (he sat on his soft-pack and liked it). 5. Curley Gilroy. His hair was voted "Most Likely to Recede." Gimmick: Staples toupee on. Also staples his roll-your-owns. 6. Right. He's still his own man. Likes his cigarette honest, no-nonsense, too. Camel Filters. Easy and good tasting. 6a. Kicky VIII, mascot. Has eyes only for Mendelson (see 2 above).

Camel Filters. CAMEL
They're not for everybody
(but they could be for you).



Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

20 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report FEB. '73.

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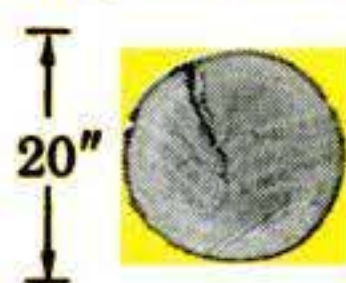
All the chain saw
you need costs just

\$99.95*



It's the 6.9 lb.**
Mini Mac 1. Only McCulloch
makes a saw this light,
for this little.

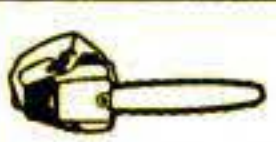
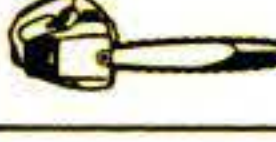
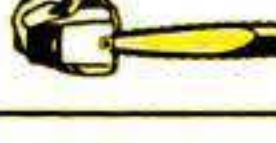
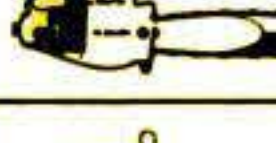
The right tool for the right job—you know that's what counts. So if all you use a chain saw for is limbing, trimming and cutting firewood around your own yard—this is *all* the saw and *all* the power you need! It's lighter than any saw in the world for the price. Its 10" bar will cut a 6" log in just 5 seconds and even zip through 20" logs. And it



comes with something you just can't acquire anywhere else—McCulloch's 26 years of professional chain saw engineering know-how. When you can get a McCulloch for \$99.95 why pay more?



If you have bigger jobs, or heavier cutting, check this chart. McCulloch has the right saw for every job.

McCulloch Model	Best For	Weight**	Engine	Bar	Price*
 Mini Mac 1	All the saw you need for the average yard.	6.9 lbs.	1.8 cu. in.	10"	\$ 99.95
 Mini Mac Electric	Can be used outdoors as well as indoors.	7 3/4 lbs.	110V, 60 cycles, 12 amps, double insulated.	10"	\$ 99.95
 Mini Mac 1 Automatic	Longer bar for bigger logs, wood and heavier cutting.	7.1 lbs.	1.8 cu. in.	12"	\$119.95
 Mini Mac 6 Automatic	Deluxe hand grip and longer bar for heavier cutting.	7.1 lbs.	1.8 cu. in.	14"	\$136.95
 Power Mac 6 Automatic	More power for orchards, ranches, farm jobs.	6.9 lbs.	2.0 cu. in.	14"	\$169.95
 Mac 10-10 Automatic	"Sound silencer" for heaviest ranch and farm work.	12.4 lbs.	3.3 cu. in.	16"	\$194.95

See your McCulloch dealer—He's listed in the Yellow Pages under "saws."

McCulloch McCulloch Corporation, 6101 West Century Blvd., Los Angeles, Calif. 90045

*Manufacturer's suggested list price, including bar and chain. Prices slightly higher in Canada and Alaska.

**Weight less cutting attachments.

Recreation

... on the go with PS—

Study finds most RVs overloaded

A preliminary report on the National Highway Traffic Safety Administration's inspection of nearly 9000 recreational vehicles during 1971-72 reveals that a shockingly high percentage were loaded "beyond their suspension-system capacities."

These data are based on 833 pickup campers and 214 motor homes, with the other reports to come.

The government found that 63 percent of pickup campers were loaded beyond the capacity of rear suspensions. In 54 percent of motor homes inspected, front-end loads exceeded strength capacity of front suspension. And 27 percent of the motor homes were overloaded in the rear, too.

The responsibility for this may be due more to manufacturers than RV owners. The report said that 71 percent of pickup-camper owners did not receive proper weighing instructions for their rigs. Some 44 percent of pickup campers were delivered with "erroneous or ambiguous rating plates which overstate the capacity of their suspension components."

Even more surprising was the finding that 43 percent of motor homes had front suspensions "whose strength capacities were exceeded by the weight of the vehicles' front ends plus the weight of occupants in the two front seats."

Surprisingly, the government also found that few RV owners inflated tires to maximum pressure, which would help cope with heavy loads. But the findings indicate that RV buyers did not get clear instructions from manufacturers on this subject.

NHTSA officials told me that most of the vehicles surveyed were pre-1970 vintage. More recent safety standards have resulted in clearer labeling of GVW and axle-load ratings. This year, manufacturers must specify more clearly the allowable zone for cargo-load center of gravity.

Owners—and manufacturers—of the vehicles inspected will receive detailed analyses on what was found. The government is asking the latter to study the findings and submit to NHTSA "plans to correct problems in all their vehicles similar to those examined during the survey."

Owners are being advised to weigh their rigs periodically to assure that GVW will not be exceeded. They are also being urged to inflate tires

Roundup

on and off the road



By HERBERT SHULDINER



AMC unveils a new series of four-wheel drives

Take a Wagoneer and shorten the wheelbase. Then drop a bunch of Wagoneer luxury items. And you wind up with the new moderately priced Jeep Cherokee. This two-door recreational rig has a 109-in. wheelbase and Quadra-Trac full-time four-wheel drive. It's available with a basic 232-cu.-in. six-cylinder, or optional 360-cu.-in. or 401-cu.-in. eight-cylinder engine.

when they are cold, and not to bleed air when pressure rises in driving. There will be three other surveys released shortly covering travel trailers, tent trailers, and towing vehicles. They are also expected to reveal potentially hazardous conditions in need of correction.

Gas-saving ideas for RV drivers

Increasing concern about gas availability has brought forth a spate of tips on how to stretch the gallon. Slowing down is one of the most recurrent bits of advice. So I decided to test it out recently.

I drove a Superior V-1700 van camper—on a Chevrolet Chassis—from New York City to Boston, never exceeding 50 mph and accelerating slowly. On the way back, I traveled at speeds of up to 65 mph and floored the accelerator every time I started up. The results showed 11.51 mpg when holding speed down and 8.56 when traveling at 60-65.

I'll be testing some additional RVs in the near future to see if there's a comparable saving when I slow down. From this trial run, I'd say that reducing speed is good sense.

New CG guide to life jackets

As predicted in Doug Garr's article "A Life-Saving Guide to Life Jackets" [Feb.], new Coast Guard standards on personal flotation devices (life jackets) and their use in

small boats take effect next month.

The Coast Guard has ordered that there must be a wearable PFD for each person aboard boats 16 feet or longer, as well as a throwable device. Buoyant cushions will still be acceptable on canoes, kayaks, and boats under 16 feet—as long as there is one per person. But the CG recommends wearable PFDs on small boats, too.

Super towing package on '74s

Chrysler has come up with the most complete towing package offered by Detroit for its 1974 models. It even includes Class I bumper hitches for light trailers, and equalizer-hitch platforms for towing heavier trailers. Chrysler is also offering a more complete electrical wiring harness with connector. It provides for charging dual battery installations and controlling trailer brakes.

These items will be available on all models from Valiant to Imperial, and are in addition to the existing trailer-towing packages. These already consist of heavy-duty frames, wider wheels, heavy-duty cooling systems, and other components that make trailer towing easier.

Ford has also introduced some new features for towing. Among them, a new equalizer-hitch platform for full-size Fords. It already offers a Class I hitch for the standard Ford. Neither item is available for intermediates or compact cars. **PS**

Power to go



McCulloch Portable Generators

Here's electric power where you need it, when you need it—on camping trips, outdoor building projects, for standby power during storms, blackouts and other power emergencies.

McCulloch's super lightweight generators are small enough to fit in the back of your car. And the unique design, with only one moving part, means they're the most reliable you can buy. Three sizes, all with our Double Warranty.

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H-1500. 1,500 watt capacity. 68 lbs. 115 volts. 60 cycles.

Only **\$199⁹⁵***

H-2000. 2,000 watt capacity. 83 lbs. 115 volts. 60 cycles. **\$289.95***

H-3000. 3,000 watt capacity. 129 lbs. 115 or 230 volts. 60 cycles. **\$399.95***

McCulloch

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*Manufacturer's suggested list price. Slightly higher in Alaska and Canada.

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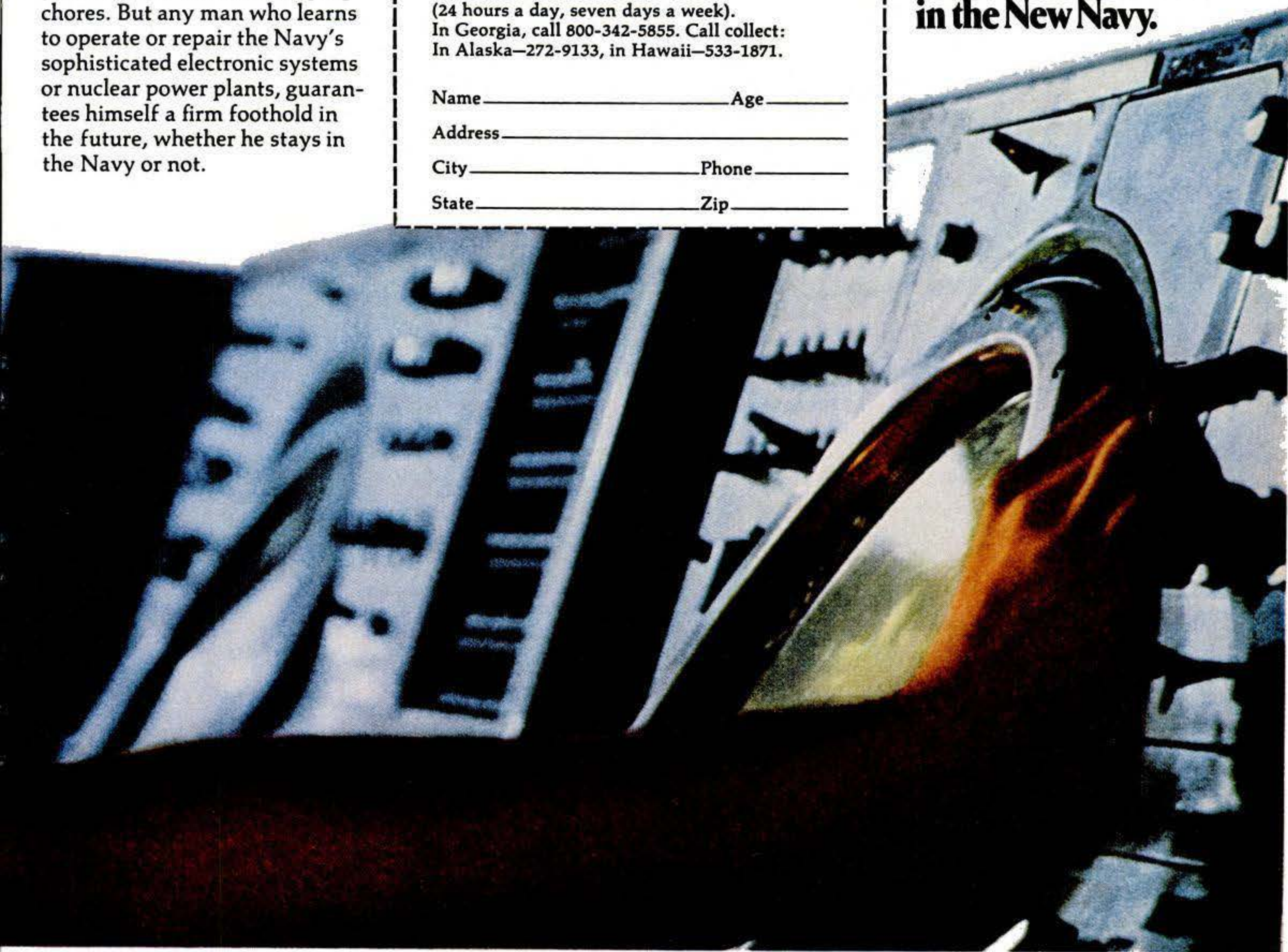
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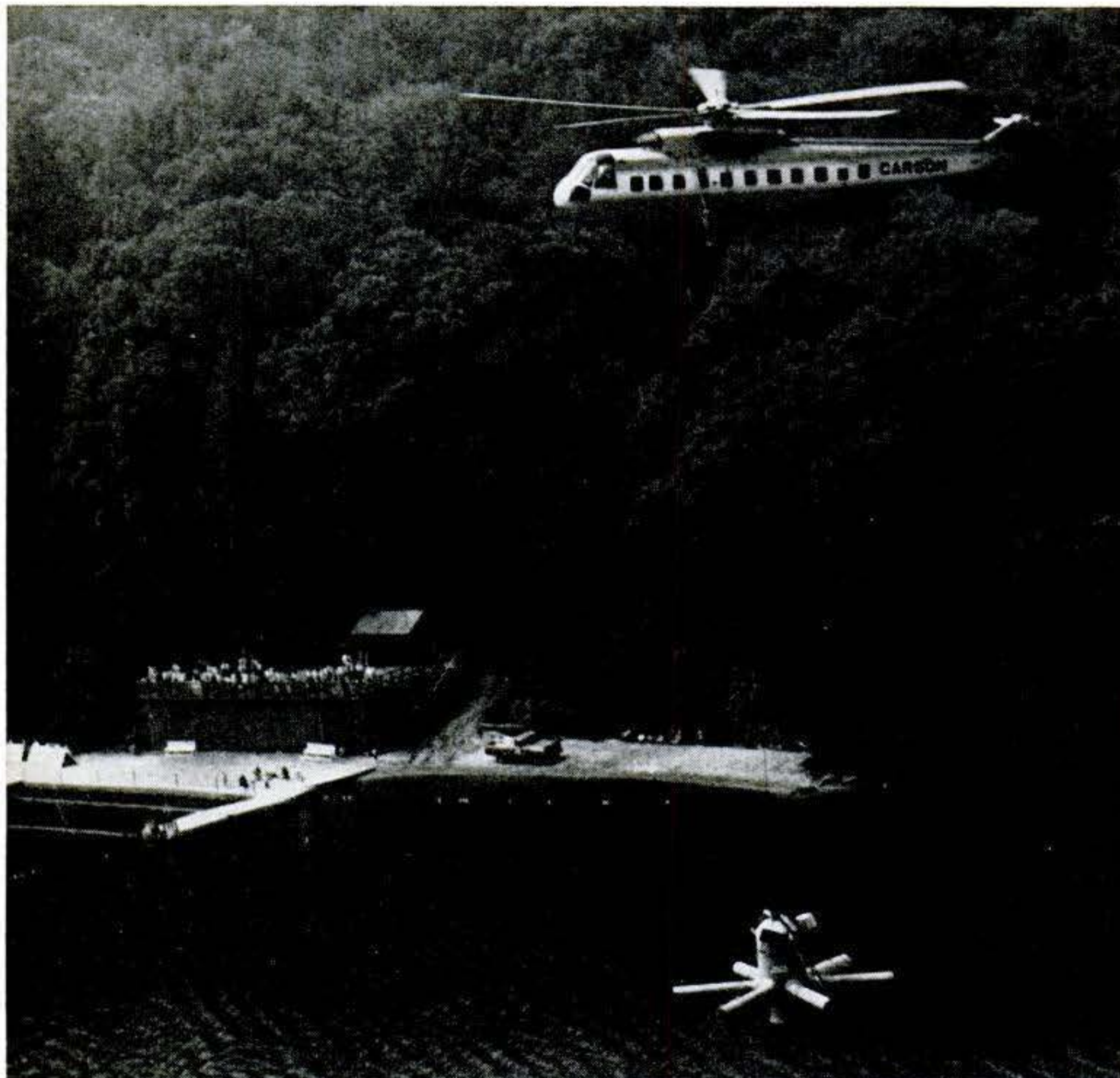
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Science Newsfront

Last-minute news and notes to keep you up to date By ARTHUR FISHER



Aerators airlifted to save decaying lake

Two giant aerators have been plopped into the oxygen-starved bottom of New York's Lake Waccabuc in an attempt to arrest the decay of the lake, which would otherwise become completely eutrophied in about 15 years. Funded and operated by Union Carbide, the project is part of a program to evaluate the best way of preserving hundreds of thousands of our lakes. The 1400-pound fiberglass aerators are made by the Swedish Atlas Copco Co.

Heaviest particle

A team of physicists from the University of Leeds in England reports detecting what may be the heaviest nuclear particle ever found, with 40 times the mass of the proton. Tentatively dubbed the "mandela," the particle was discovered with a cosmic-ray detector.

One member of the Leeds group thinks it may turn out to be the legendary "quark," predicted by some particle physicists but never found; a second believes it is another theoretical particle, the intermediate vector boson. Physicists need this particle as a "carrier" in the weak atomic interaction, one of the basic physical forces in the universe.

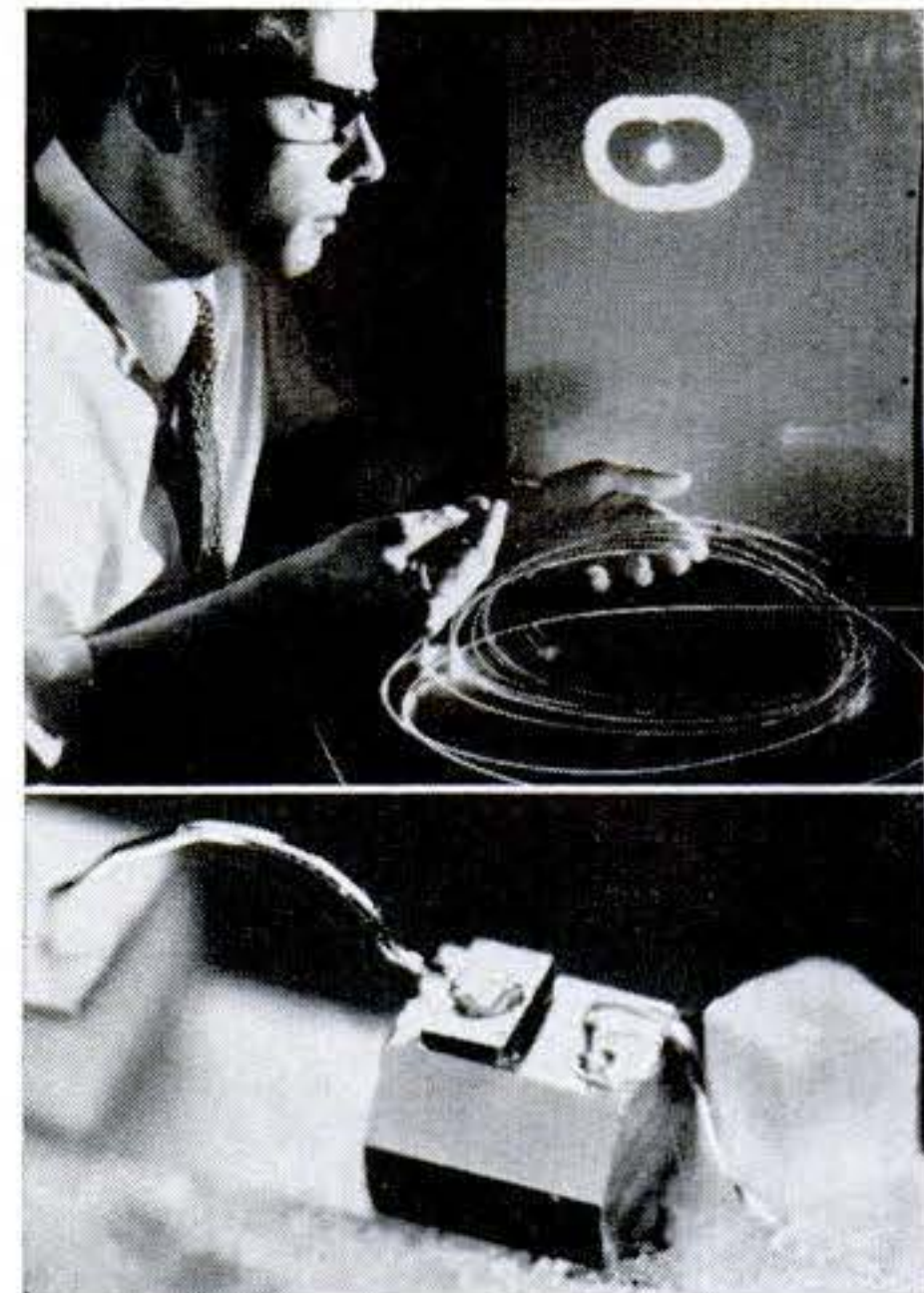
Light conversation

One of the most sought-after goals of modern technology is an optical communications system for carrying sound, video, and data signals. The reason: modulated light beams would have a much greater information-carrying capacity—thousands of conversations over one beam, for example—than present transmission systems, which are groaning under the flood of communications they must handle.

Now two developments from Bell Labs have brought such a system somewhat closer to reality. One is the first efficient light-carrying fiber to be made from a single material—pure glass. The hair-thin fibers

would be bundled into a cable like that shown in the top photo. The new fiber has a light loss of only 50 percent in 2000 feet, which would allow signal amplifiers to be placed even farther apart than in present RF cable systems.

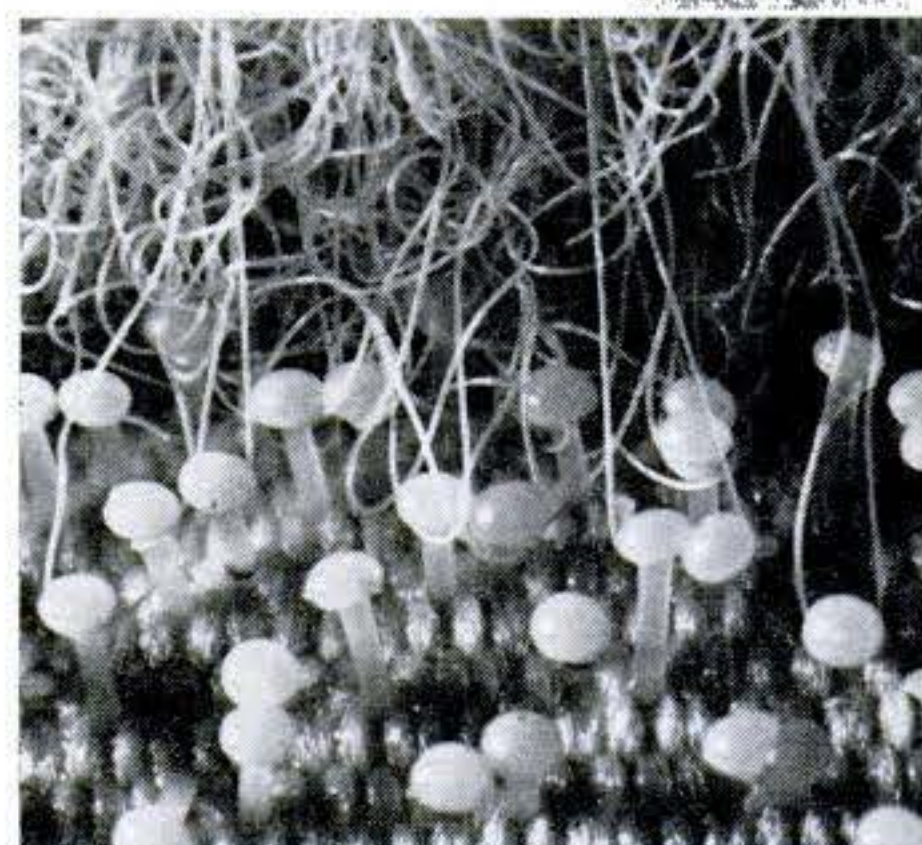
One other vital ingredient for the system is a reliable and economical source of laser light. The tiny bat-



tery-powered semiconductor laser shown in the bottom photo (the small rectangle atop the block with a grain of salt for comparison) may be the answer. Bell Labs scientists have kept it operating continuously at room temperatures for more than three months.

New fastener

You're undoubtedly familiar with the hook-and-loop type of fastener that can be peeled open and re-closed indefinitely. The new Scotch-



mate High Strength fastener looks like the old-style stuff, but when you try to peel it open, you get quite a surprise: It takes far more effort to "unzip."

The reason is clear in the photomicrograph shown here. Instead of

Science Newsfront

[Continued]

mating to nylon hooks, the nylon loops get snared on mushroom-shaped structures of polyolefin. The fasteners are good for about 20 closures, and are recommended for such applications as mounting panels in trailers and mobile homes, and hanging loudspeakers or other equipment.

Going for the distance

What is the farthest object in the universe? The answer keeps changing, as new quasars are discovered. These mysterious objects, whose nature has never been satisfactorily explained, put out seemingly impossible amounts of energy for their size. Their light is also so red-shifted (moved toward the red end of the spectrum, presumably by the Doppler effect) that they appear to be dashing away from us at incredible speeds and distances.

Astronomers at the University of California have now found a quasar that may be 10 billion light years away, traveling, according to its observed red shift, at 90 percent of the speed of light. The object, designated OQ 172, may thus be on the "edge" of the observable universe. If this distance is correct, it is also one of the brightest objects known, about 10,000 times brighter than the whole Milky Way.

No. 104 is for real

Oak Ridge National Laboratory has announced positive identification of man-made element 104, following its discovery reported—in contesting claims—in Russia and at the University of California at Berkeley. An Oak Ridge team reports conclusive confirmation on the basis of direct X-ray evidence.

Saving Salton Sea

A dramatic plan to save sportfishing in threatened Salton Sea has been proposed by a group of scientists, engineers, and civic leaders in California. The salt content of the inland sea is now 37 parts per thousand, and increasing steadily. By 1980, it will reach 40 ppt. And at that point, marine biologists know, fish eggs cannot develop normally. The present stock of marine game fish, originally transplanted from the Gulf of California, would be doomed.

Forewarned, scientists from the California Fish and Game Department, Scripps Institution of Oceanography, and the National Oceanic and Atmospheric Administration have come up with a plan to create a "lake within a lake" by diking off about 50 square miles of the 450-square-mile sea. This control area would have desalination equipment that would remove 5½ million tons of salt a year from inflowing water, and recirculate the purified water to the main body of the sea, thus reducing its salinity to a level that will permit the Salton's fish to survive.

Look ma, no fat!

A somewhat mysterious substance known to help break down fat in the bodies of fasting human beings, and called, for want of a better name, the Fat-Mobilizing Substance (FMS), can now be obtained and purified in quantity, even though its exact chemical makeup remains unknown. Experiments with FMS on animals at Loyola University Stritch School of Medicine indicate it may prove useful to dieters.

Quiet paint

Under a grant from the Army's Human Engineering Laboratory, scientists at Lehigh University are developing a noise-reducing latex paint whose molecular structure damps vibration. It's made from acrylic and methacrylic polymers.

PS

THIS MACHINE CAN TAKE YOU FISHING.



It's Laredo's cigarette-making machine. Makes 20 great-tasting cigarettes at less than 20¢ a pack*, a big difference compared to factory-made cigarettes. You pocket the savings that can soon take you on fishing trips, or buy some of life's other little pleasures... from a new rod 'n reel to you-name-it. Freshness, flavor and big savings! Get them all for just a few easy minutes every day. Land a Laredo Filter Blend Kit now. What a catch!

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FILTER BLEND



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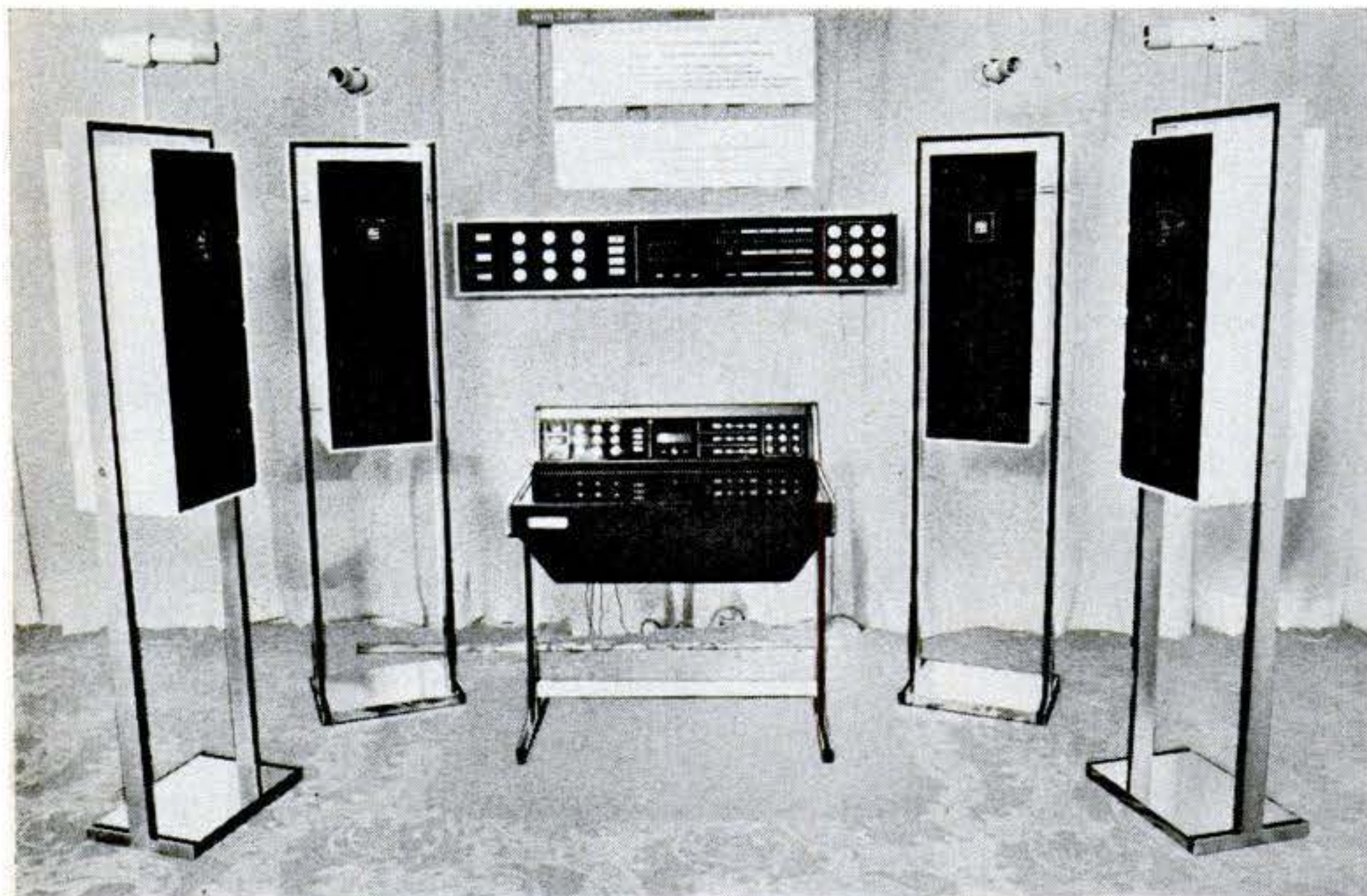
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Look and Listen

News, comment, and opinion from the world of home-entertainment electronics

By C. P. GILMORE



Four-channel receivers—a glimpse into the future

A lot of companies are working to perfect systems of broadcasting discrete four-channel signals. Two of them recently demonstrated what they're doing. At the recent Consumer Electronics Show in Chicago, for example, General Electric set up its system in cooperation with station WFME-FM and broadcast experimental programs under temporary FCC authority. The broadcasts were picked up by receivers at the GE booth at the show.

Zenith set up the display you see above in its Michigan Avenue showroom. It goes considerably beyond mere four-channel broadcasting, and shows how Zenith engineers see the hi-fi world of the future. The system receives any kind of mono, stereo, or Zenith four-channel broadcast and plays any recorded material on disc, cassette, or cartridge. The console at center contains no knobs, slides, or switches. Touch the right square, circle, or rectangle on the display and sensors behind the panel note the touch and command the proper control circuit. As you touch a tuning control, for example, an automatic circuit scans the broadcast band and stops when you lift your finger.

The system also solves the problem of how to hide those troublesome wires in a four-speaker system. The rear speakers are connected to the amplifier by invisible waves of infrared light, received by those telescope-like gadgets on top of the cabinets. Finally, an automatic digital display tells you the station to which you're tuned; when the set is off it tells time.

More video diskery

MCA has shown an improved version of its Disco-Vision system [L&L, March '73]. The picture, according to those who saw it, was steady and clear and a considerable improvement over the picture seen three months earlier.

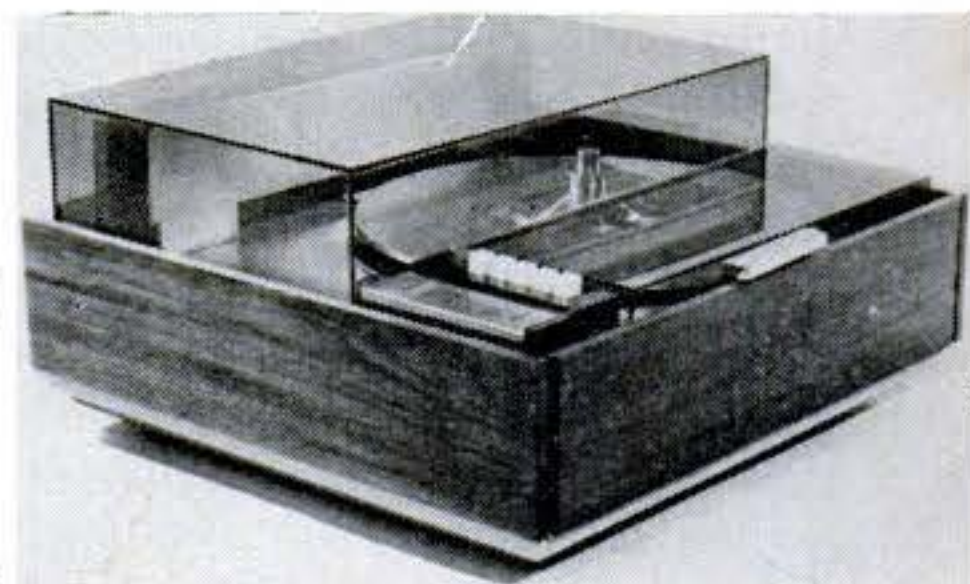
The machine was capable of several new tricks. Push one button and a single frame stays on the TV screen as long as you like. Another feature called fast search finds any segment of the disc in a hurry. The record shown contained 21 minutes of program material—14 minutes

more than the one first demonstrated, but still only about half the claimed 40-minute-per-side capacity. The discs should sell for between \$5 and \$10. MCA says a single-disc player (picture) will sell for about \$400, a changer for \$500. No manufacturer has been selected yet.

At about the same time MCA was demonstrating in this country, a Swiss physicist was showing a remarkable device at a European TV symposium. One big problem in devising a home video recording system is the camera. Now since we're all used to color, most of us won't be satisfied with a black-and-white

camera. Yet even black-and-white cameras cost around \$300; color cameras are much higher. Now, Dr. Jaeger has shown a color camera that he says can sell for an incredibly low \$300-\$350.

Trick is that it uses a single black-



and-white low-cost videcon tube, which photographs pictures sequentially through red, green, and blue filters. This obvious approach hasn't been used before because it would ordinarily produce a low-resolution picture. But Dr. Jaeger says he has used a principle discovered 30 years ago at Bell Labs—never put to work in TV before. The principle, he says, is that an extra dose of green in the picture can compensate for lack of resolution.

The camera could be used on any home video system or even with a regular TV set through an adapter.

Progress report on SelectaVision

RCA says that the SelectaVision magnetic videotape system [L&L, June '72] will be on the market in limited quantities late this year as originally announced. The record-playback unit with built-in timer will cost \$795. RCA also made two



other announcements. A black-and-white camera—the one the young lady in the picture is holding—will be available for about \$300. And a rent-or-buy library of about 100 prerecorded tapes will be available, although RCA thinks people will be more interested in making their own recordings off the air or from TV broadcasts.

RCA President Anthony Conrad also took a slightly more distant look and said that the SelectaVision video-disc system will be on the market in a year.

Photographed on Vancouver Island, British Columbia



Canada at its best.

Try the light, smooth whisky that's becoming America's favorite Canadian.
Imported Canadian Mist®

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A Coleman heater.

Rugged. Dependable. Made to last a lifetime. And it will. Because Coleman doesn't believe in cutting corners.

Take the outer case—cold-rolled steel, coated inside and out with baked-on enamel. That's the toughest casing you'll find on a cat heater anywhere.

And the Dial-Temp[®] control. When you set it, you forget it because only Coleman guarantees you constant, full-rated heat output regardless of outside temperature.

Inside there's a platinum catalyst. Platinum to allow the fuel vapor to burn at its most efficient temperature. Platinum to allow you safe, radiant warmth for up to 30 hours at a stretch.

And the wick could have been cotton. But it's not—it's fiberglass. For quicker starts, for more efficient combustion. For just all 'round better heating.

Like we said, Coleman doesn't believe in cutting corners. Our gas cats prove it.

Ask someone who has one.



Keeping You Posted from Behind the Scenes

One result of our national concern about air pollution and energy conservation seems certain: The automobile industry will never again be totally dominated by a single concept of engine design. Alternatives to the conventional piston engine didn't stand a chance as long as the only incentive was to build the cheapest engine possible for next year's models. Promising designs never got the opportunity to benefit from the years of developmental engineering that gave the internal combustion engine the winning edge on the balance sheet for over 50 years.

Now with government funding of research and the powerful incentive of meeting mandatory emission standards (and probably fuel-economy standards in the near future), we are looking forward to a rich diversity in automotive power. The rotary combustion (Wankel) and stratified-charge (Honda CVCC, Ford PROCO) engines are already accepted as practical contenders. In this month's cover story (page 56), Jan Norbye and Jim Dunne tell you all about the revived interest in the gas turbine. There are still problems to be solved, but it looks now as though the turbine will make it for top-of-the-line cars.

Turning on flywheel power

Research on using a flywheel to store energy for vehicle propulsion [PS Aug. '73, Aug. '70] got a boost recently when the DoT gave \$300,000 to the City of San Francisco to design such a system for use on its trolleys. The design will use the flywheel system developed by engineers at Lockheed Missiles and Space Co. The flywheel for the trolley system will be much larger than the one we told you about last month, which was proposed for a private car. It will be 41 inches in diameter, weigh 600 pounds, and spin at 20,000 rpm. The grant is for design studies only.

Buckle up or you won't go

In spite of all the stories that have been written about the seat-belt interlock system required on all 1974 cars, too few auto buyers realize that their new '74 model won't start unless the front-seat occupants buckle their safety belts. Even a bag of groceries placed on the seat beside you counts as an occupant—you'll either have to buckle up the groceries or put them elsewhere or your engine won't start. The people at the National Highway Traffic Safety Administration anticipate howls of outrage from new-car buyers unless all drivers can be made completely aware of the ramifications of the system before they drive their new car home. Therefore, they have mounted a large-scale publicity campaign to inform the public. You've been alerted. Next month we will bring you a feature story telling how the seat-belt interlock system works.

Wind-energy workshop

The National Science Foundation (NSF) and NASA cosponsored a three-day symposium in Washington, D.C., this summer on energy from the wind. Associate Editor Doug Garr attended

it and reports that several of the speakers quoted from the November 1972 issue of POPULAR SCIENCE. Two wind-generator designers, Tom Sweeney and Hans Meyer, who were featured in our November story, presented papers.

Generally, there were two kinds of wind-power proponents—those interested in efficient designs for domestic power plants for individual homes in locations remote from power lines, and those who are convinced that wind power is practical in many locations for supplying electricity to a community. A German scientist, Ulrich Utter, told about his 100-kw, 34-meter-diameter turbine, and Henry Clews of Solar Wind Corp. described his home in Maine that is completely powered by a two-kw wind generator using 20 storage batteries and a DC to AC inverter. Another report described a Voight 750-kw wind generator in Oregon with a monster 100-foot rotor. Grumman has a design for a shrouded windmill intended to increase velocity using the venturi effect for faster rpm with lower windspeed. The general conclusion of all researchers: Progress is seriously impeded by lack of research money. Fiscal 1973 saw only \$200,000 of NSF money allotted to wind-energy research. Next year they tentatively plan to spend about \$1 million.

More energy from the earth

A team of scientists and engineers at Louisiana State University want to harness a triple-threat source of energy beneath the earth's surface consisting of very hot, high-pressure water believed also to contain natural gas. Out in Marysville, Mont., scientists from Battelle-Northwest are leading an investigation of how best to tap the energy in dry hot rocks found near the surface. Both of these projects are aimed at forms of geothermal energy different from the more familiar sources of underground steam described in our article "Hot New Prospects for Power from the Earth" in August, 1972.

The Louisiana team has built a model showing how the thermal energy could be used with a Freon cycle to drive "steam" engines [PS Aug. '73]; the force of the gushing water (estimated at 2000 to 4000 psi) could drive a hydraulic turbine; and the gas content could be separated for use as fuel. With technical assistance from oil companies, the LSU team hopes to plan and direct the drilling of a well to tap the hot geopressured water pool that underlies the Gulf Coast from Florida to Texas. Federal research funds are being sought for the first phase of a projected five-year program to establish a full-scale prototype power plant in Louisiana.

The Battelle scientists now investigating the potential of the large-scale heat source in Montana have received a grant of \$250,200 for the first phase of their work. They plan to bore a well into the geologic anomaly deep enough to reach a temperature of 800 degrees F.

Hubert P. Luckett

Editor-in-Chief

For the

By JAN P. NORBYE

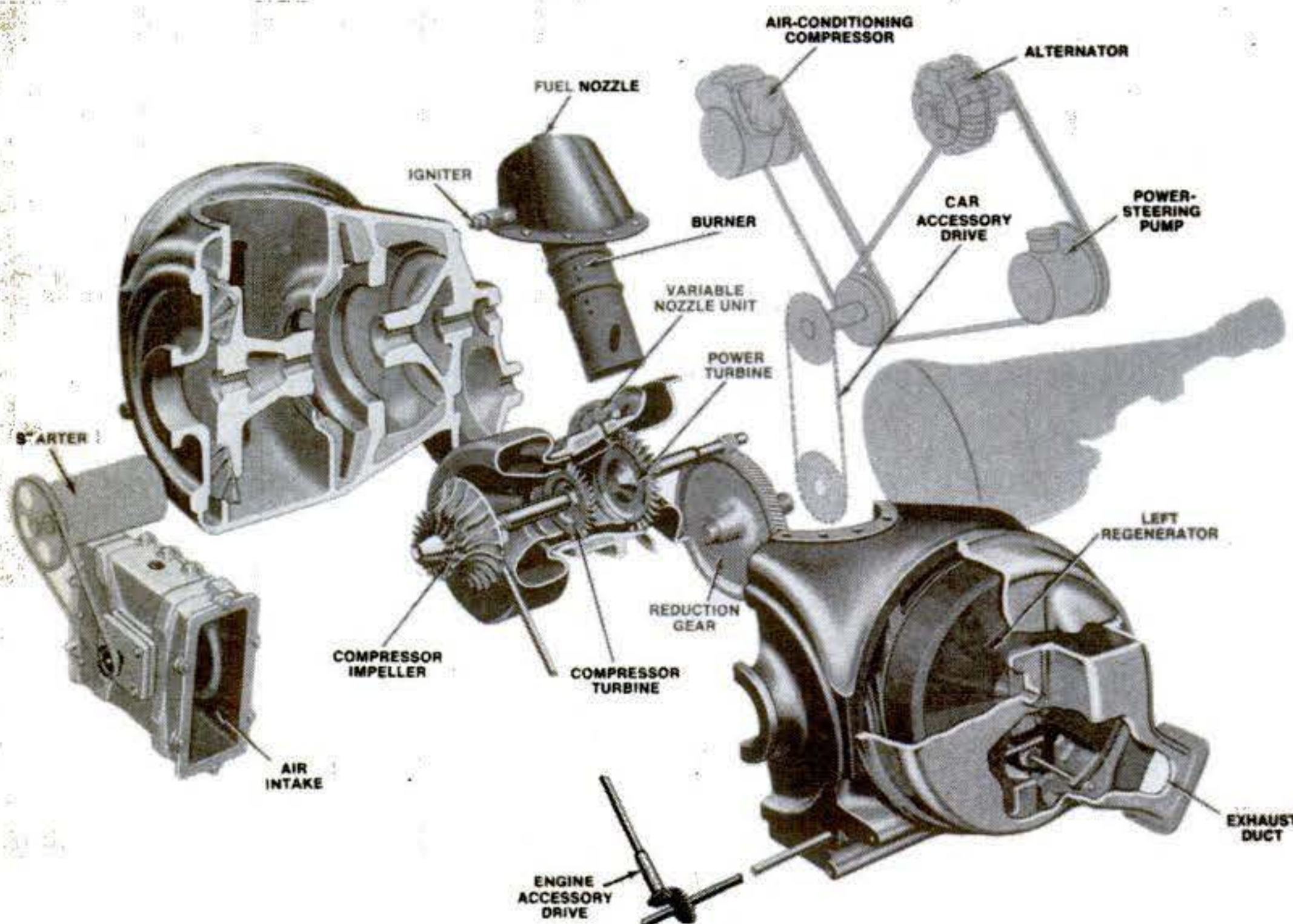
PS Automotive Editor

and JIM DUNNE / PS Detroit Editor

DRAWINGS BY HANK TOMKALSKI

"Will the real auto engine of the future please turn itself on?" There are quite a few contestants (see box below) but it now looks as though the gas turbine is ahead. You probably think the gas turbine never made it as a car engine. Didn't Chrysler bury the turbine car almost 10 years ago? Well, it's back, and with more promise than ever.

You want results, not promises? Okay, you'll get results, and by the end of 1975, according to the timetable the Environmental Protection Agency has set for its turbine program. If the results meet or better the goals, Chrysler can be expected to start tooling up for turbine cars; if not, you can forget about turbine cars. The EPA program has been going on since early '71 and that's why



Chrysler A-128 gas turbine is installed in a Dodge Coronet (top). Exploded view above shows major components and accessories, including Torque-Flite automatic transmission and hydraulic torque converter. For gas flow path,

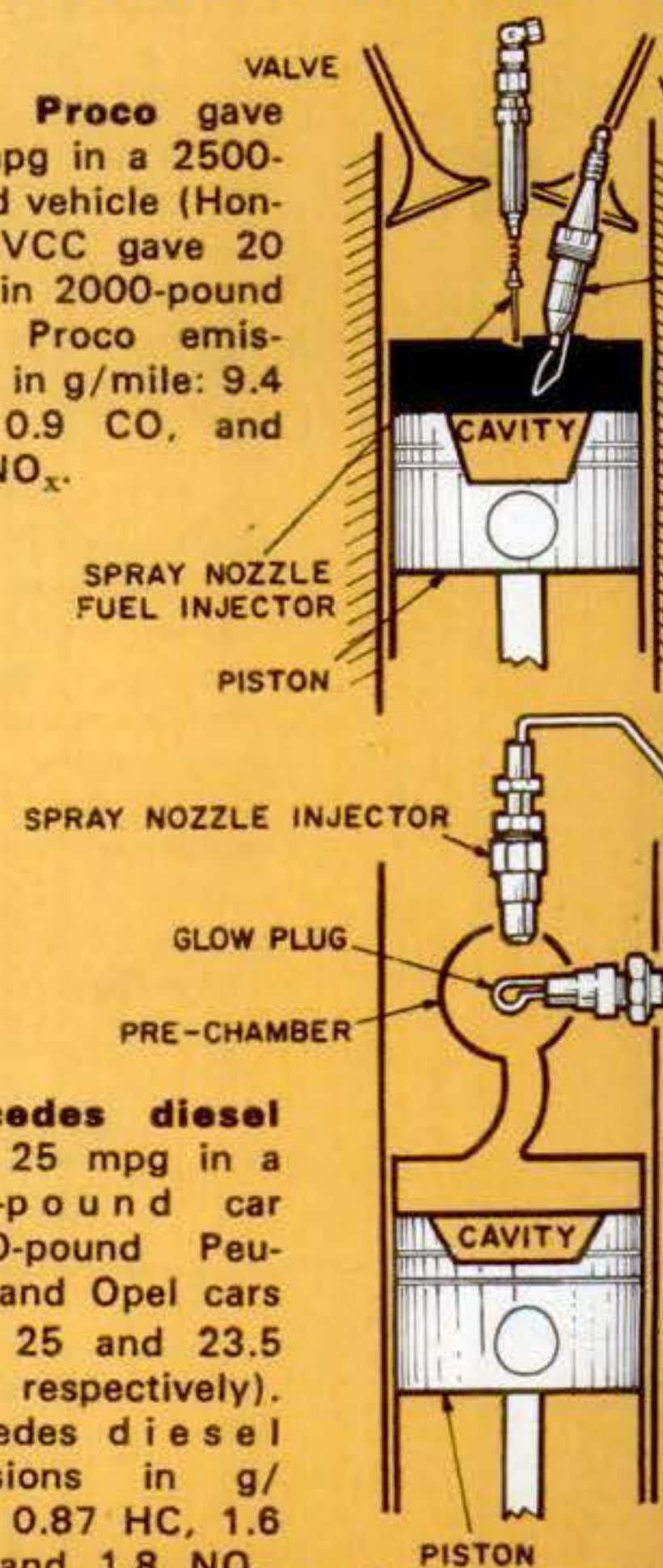
check back with PS cover flap. Table below compares fuel economy of the turbine-powered Coronet with that of a '73 V8-powered Coronet of similar performance, in various driving cycles. The final line shows targets for '75 turbine.

DODGE CORONET FUEL ECONOMY (MPG)

	FED. TEST PROCEDURES	SUBURBAN CYCLE	COUNTRY CYCLE	VEHICLE LIFETIME
GAS TURBINE BASELINE	7.7	15.0	15.6	11.5
UPGRADED GAS TURBINE	11.7	22.0	21.5	16.9
'73 MODEL YEAR V8 (with equivalent performance)	10.1	20.1	16.5	14.4

How other alternative

Ford Proco gave 22 mpg in a 2500-pound vehicle (Honda CVCC gave 20 mpg in 2000-pound car). Proco emissions in g/mile: 9.4 HC, 0.9 CO, and 9.3 NO_x.



Mercedes diesel gave 25 mpg in a 3500-pound car (3000-pound Peugeot and Opel cars gave 25 and 23.5 mpg, respectively). Mercedes diesel emissions in g/mile: 0.87 HC, 1.6 CO, and 1.8 NO_x.

Gas Turbine Car, It's Now or Never

we say it's "now (1975) or never."

When the EPA was formed, it focused on emissions. Since the fuel shortage, it has shifted its goals to include economy of operation. Now the emphasis is half on clean air, half on energy conservation.

Why does the EPA sponsor basic and applied research? "We are in the business of developing a technology," stated EPA's George M. Thur. "We are advancing technology for private industry to use. We are also trying to make the industry interested in our work, and they are interested."

A year and a half ago the EPA awarded a \$6.4-million contract to Chrysler for gas-turbine development. It also has an active research program on steam power with Steam Engine Systems Corp., Watertown, Mass. But it's EPA policy not to duplicate work going on in the auto industry. Thus, the EPA has no programs on the Wankel (GM) or the Stirling (Ford).

Affiliated EPA contracts have

gone to the Solar Division, International Harvester Co., for development of a low- NO_x combustor, and to NASA for studies of the internal aerodynamics of the gas turbine.

Chrysler will benefit from Solar and NASA findings for its own development work. Its base-line engine is the 6th-generation turbine A-128, built in 1966. It was installed

Study shows gas turbine as best power system for coping with the fuel shortage and federal emission standards. Chances are it can compete with conventional engines on a dollar-per-hp basis

in a 1967 Coronet, which we drove recently. It does 0-60 in about nine seconds, has superb drivability, but lacks fuel economy. The 7th-generation gas turbine now under development will be installed in a number of 1973 Coronets (see cover).

Gas-turbine emissions. Clean-burning characteristics were realized

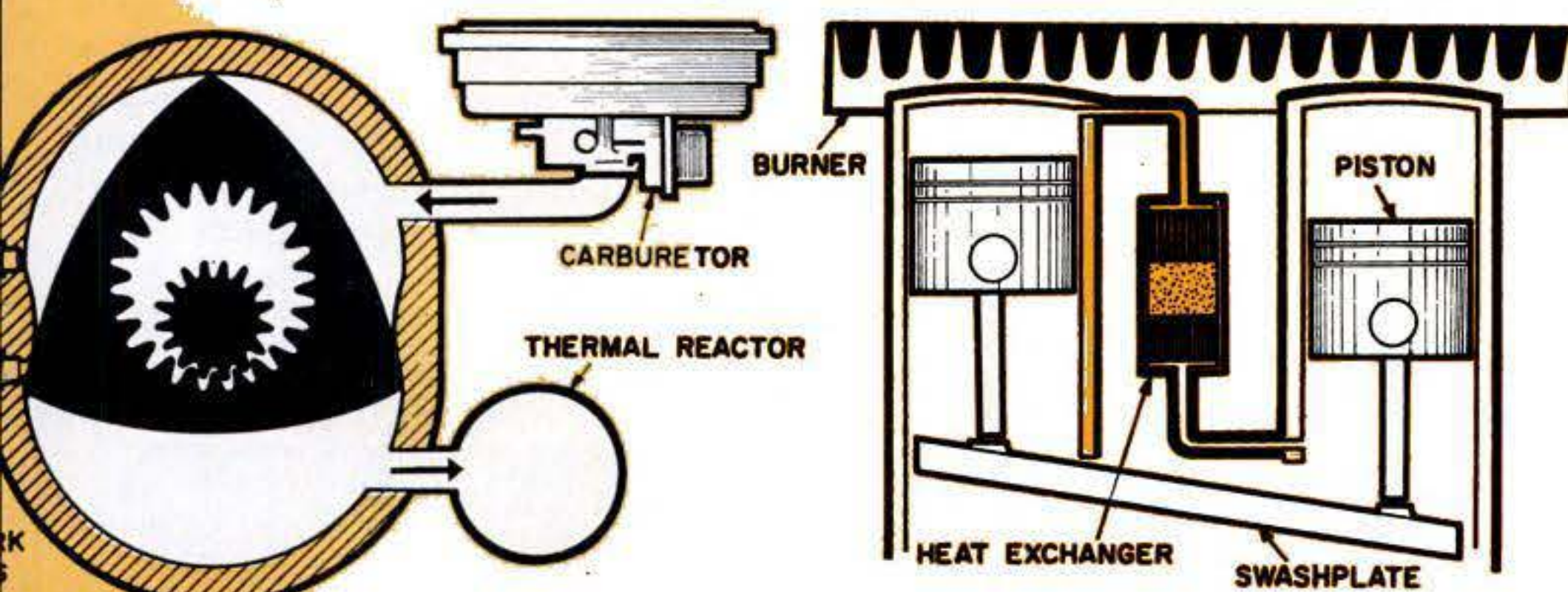
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HOW FUEL ECONOMY WILL BE IMPROVED

IMPROVEMENT ITEM	IMPROVEMENT DESCRIPTION	IMPROVEMENT GOAL	IMPROVEMENT IN MPG
1. WATER INJECTION (UPSTREAM OF COMPRESSOR)	REDUCED ENGINE SIZE FOR SAME H P	10% H P	5%
2. VARIABLE INLET GUIDE VANES	REDUCED ENGINE SIZE FOR SAME H P	12% H P	6% to 8%
3. CERAMIC REGENERATOR	BETTER EFFECTIVENESS	+ 4 Pts.	6%
4. HIGHER CYCLE TEMPERATURE	REDUCED ENGINE SIZE FOR SAME H P	7% H P	5%
5. RECOVER AND REDUCE HEAT LOSS	REDUCED PARASITIC LOSSES	50%	6% to 10%
6. POWER TURBINE	HIGHER EFFICIENCY	+ 2-4 Pts.	7%
7. COMPRESSOR TURBINE	HIGHER EFFICIENCY	+ 4 Pts.	8%
8. COMPRESSOR	HIGHER EFFICIENCY	+ 1 Pt.	2%

TOTAL 45 to 51%

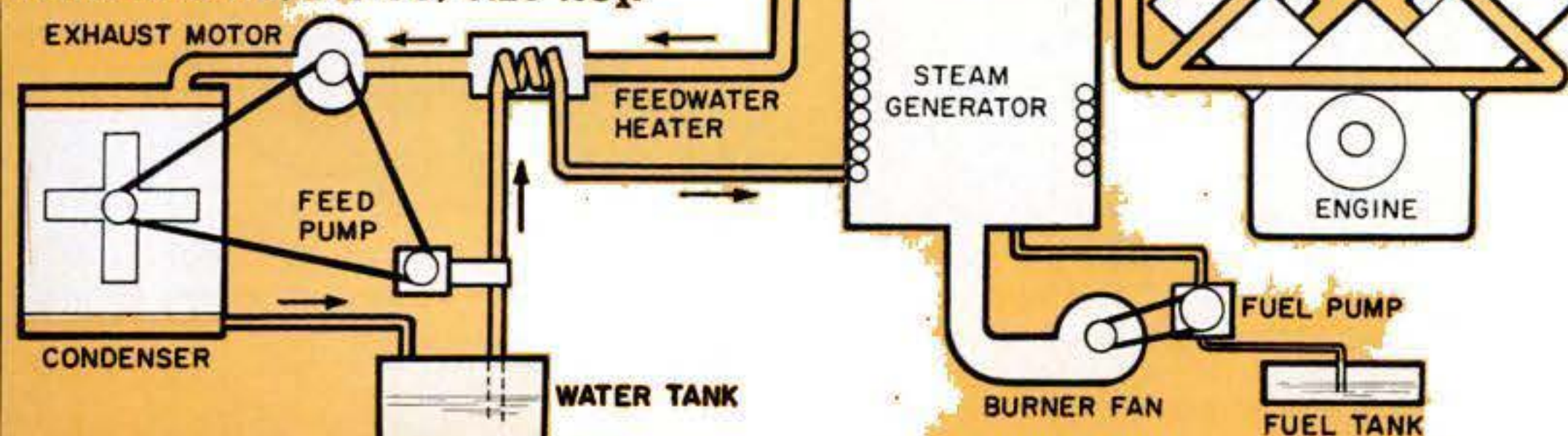
automotive power systems rate in EPA tests



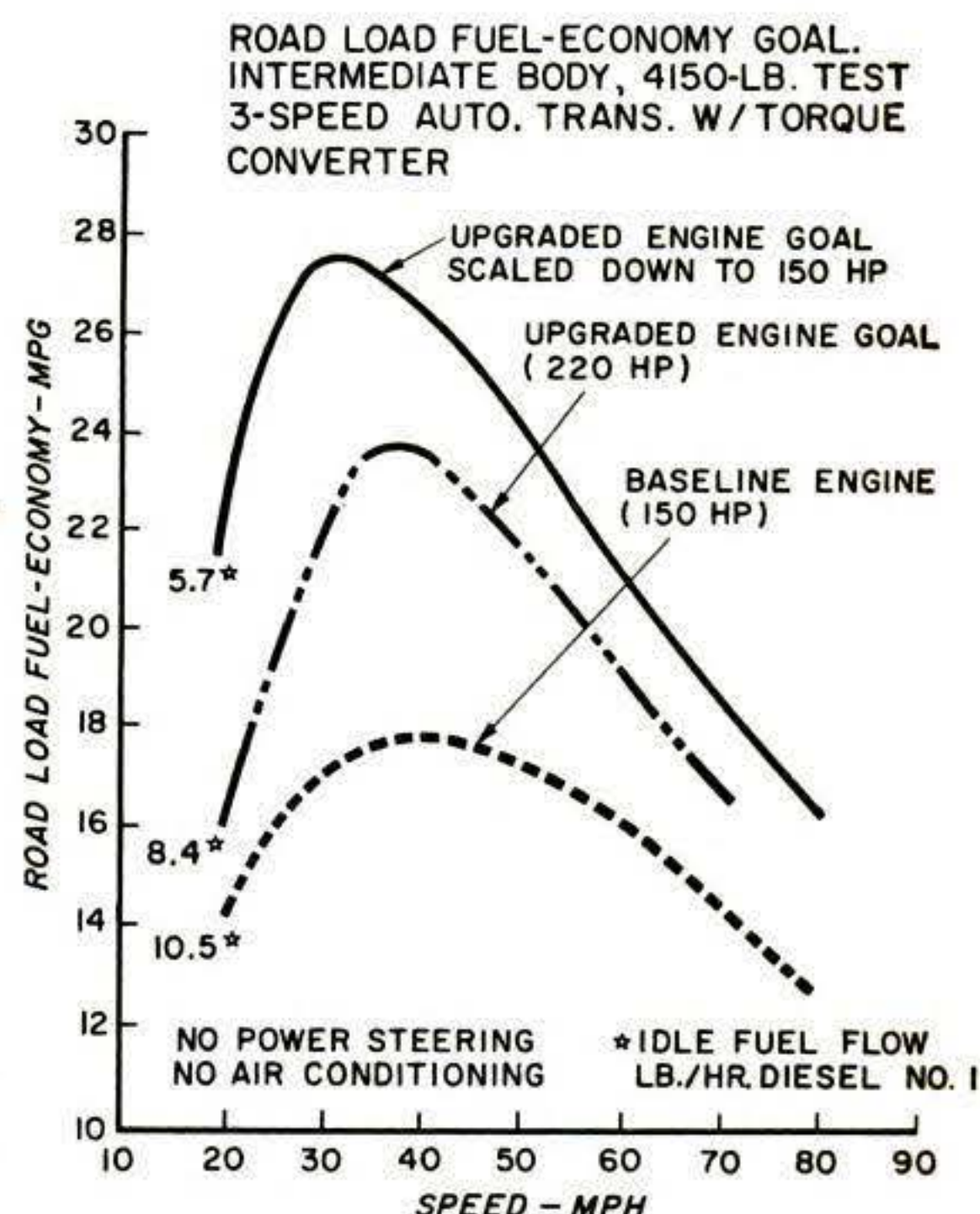
Mazda Wankel with thermal reactor gave 13 mpg in 2500-pound car. Emission levels in g/mile: 0.17 HC, 2.2 CO, 0.93 NO_x . Further cuts are possible.

Stirling-engine car has not been built. Philips-Ford calculated tests show 12.5 mpg, and ultra-low emission levels (in g/mile): 0.01 HC, 0.15 CO, 0.17 NO_x .

Simulated driving cycle of SES steam car shows 13 mpg with 4500-pound vehicle. Emissions based on component tests: 0.13 HC, 0.2 CO, 0.26 NO_x .



Chrysler sets future sights high



Chrysler's goals for turbine program go beyond the EPA contract, and call for a scaled-down 150-hp turbine engine with 25-mpg fuel mileage. The timetable is not fixed, but a prototype is likely by 1977.

George Thur (EPA): "By 1978 you'll see numbers of turbine



George Thur explains variable nozzle on Chrysler turbine—vanes direct gas flow for best economy, acceleration, or braking, according to throttle opening.



Sam Williams, of Williams Research says: "The numbers EPA and Chrysler have set as goals are reasonable. The gains are there, and very substantial."

from the start. The turbine has continuous combustion, so there is no quench effect and no unburned hydrocarbons. Since the turbine consumes vast amounts of excess air, there's extra oxygen to keep carbon monoxide levels down (and put out harmless carbon dioxide). Only NO_x emissions are a problem.

The first step is to increase combustor volume. Chrysler has a design with controlled turbulence. Solar is developing a jet-induced circulation system. EPA has a program to study the effects of water injection. NASA is working on a catalytic type of combustor. It is calculated that all methods can meet or better the 1976 standards (0.41 HC, 3.4 CO, 0.4 NO_x in g/mile). The question is which method will give most efficient use of fuel—the most mpg.

Fuel economy. The EPA began to hold meetings on the fuel shortage in the summer of 1972, and fuel economy goals were quickly introduced into the ongoing work at Chrysler, Solar, and NASA.

How a 50 percent improvement in fuel economy is obtained is shown in one of the tables. The EPA has made tests to prove the accuracy of these figures. "In fact," says George Thur, "the goals are conservative." This is backed up by George J. Huebner Jr., vice-president of research for Chrysler: "Those are things we know we can deliver under the contract. No breakthrough is involved."

Are targets realistic? Let's look more closely at the specific claims. Water injection (upstream of the compressor, i.e. at atmospheric pressure) brings a lot of benefits for the extra complexity it causes.

"It brings the engine size down,"

says Thur. "It optimizes the size for the whole cycle. Water will also reduce NO_x somewhat, and that may be the little extra that's needed. In hot weather, water injection can win back the power you lose due to higher compressor-inlet temperature. That will have a dramatic impact."

Variable inlet-guide vanes (also ahead of the compressor) are similar in principle to the variable stator nozzle on the power turbine. "They cost more to make, but they pay off in fuel economy," says Thur.

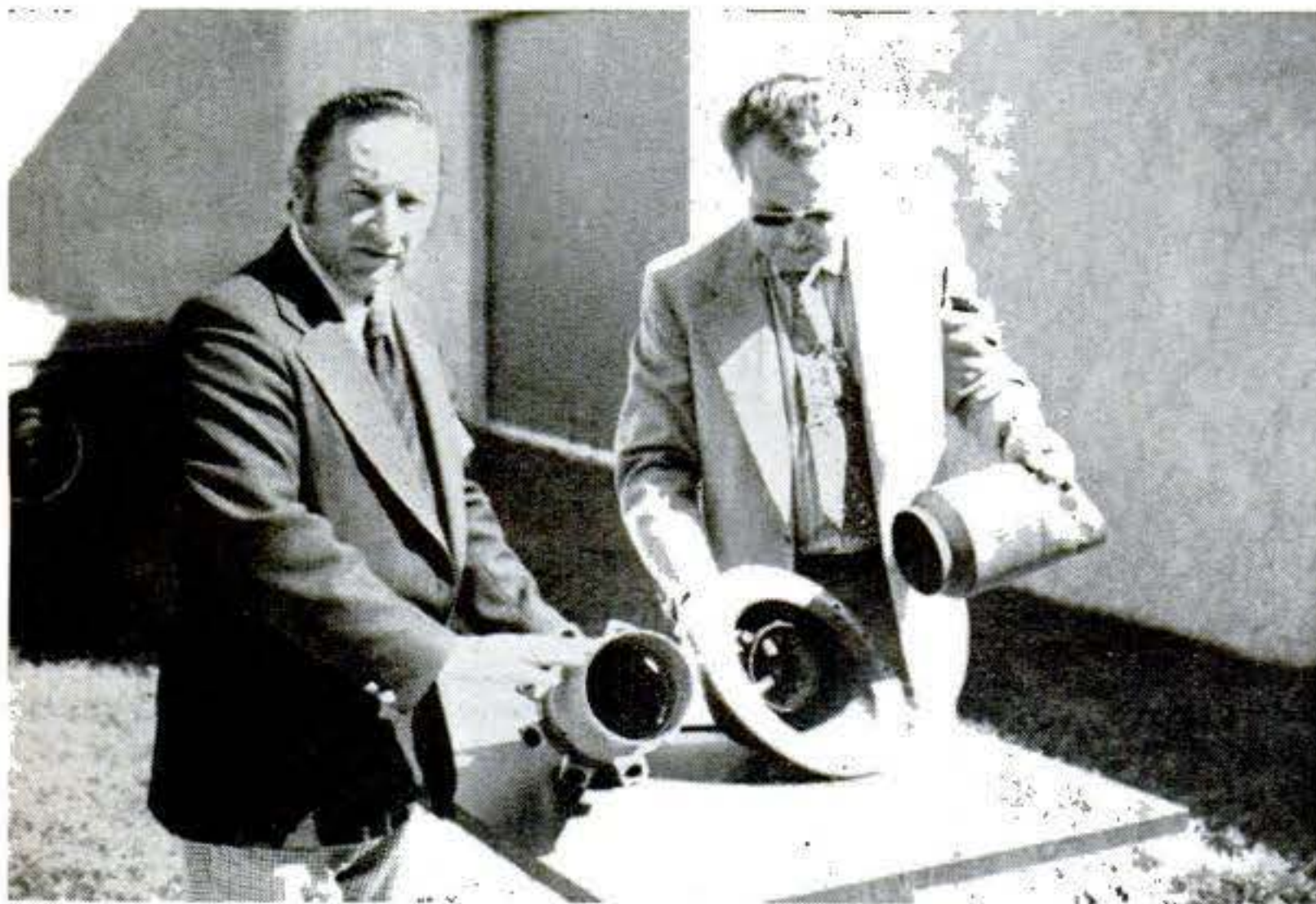
Ceramic regenerators have long been a feature of Rover (British Leyland) and Williams Research gas turbines, but Chrysler still used a metallic one on its sixth-generation turbine. Ceramic will allow higher exhaust temperatures—at least 1500° F against the 1375° F limit of the metallic heat exchanger.

"And that," says Thur, "has an impact on fuel economy—at least six percent better."

Higher cycle temperature means higher primary turbine-inlet temperature—where the gas flows when it leaves the combustor. Huebner says you get 14 percent more power for each additional 100° F you can raise turbine-inlet temperature, plus six percent more miles per gallon.

The A-128 turbine is limited to 1430° F at half speed, 1850° F at full speed (but full compressor speed is defined as a short-duration mode of operation occurring mainly during wide-open throttle acceleration). The improved turbine will be able to withstand 1490° F indefinitely and 1925° F for short bursts.

The studies on recovery and reduction of heat losses have been handed over to NASA. There's a potential power gain of 50 percent here. The problem is to locate the

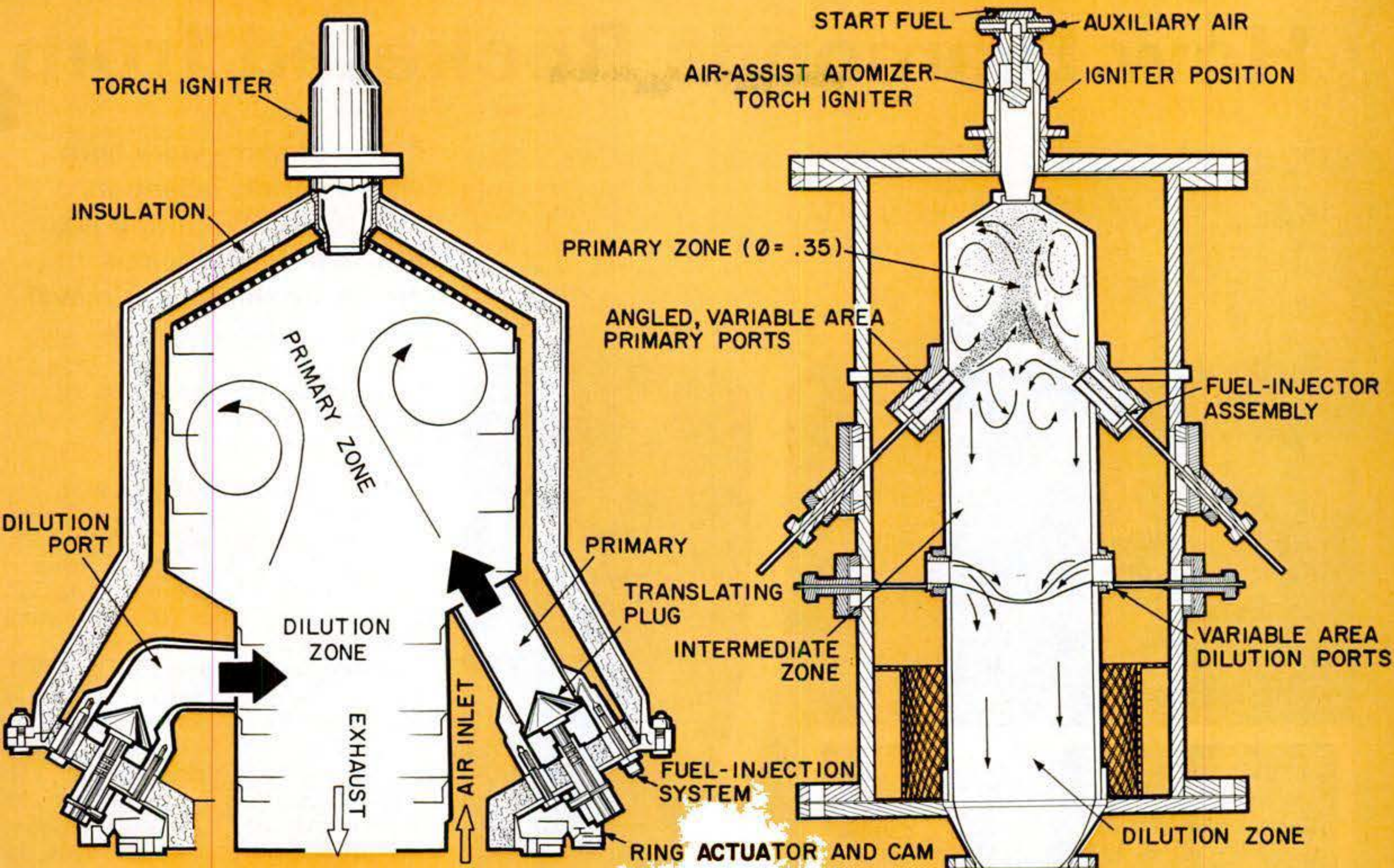


Improved control of NO_x emissions will come through better control of the combustion process, with or without water injection. Thur holds Solar combustor; Norbye, A-128.



George J. Huebner Jr. has been working on gas turbines at Chrysler since 1943. He's shown at the wheel of a test car—one of 50 built in 1963—which still performs admirably.

cars in field evaluation, in a GSA fleet, for instance."



New combustor-design proposal from Chrysler provides an enlarged diameter in the primary zone, with controlled turbulence that promises to improve fuel atomization and sustain combustion with leaner air/fuel ratios for better economy.

Big feature of the Solar combustor is jet-induced circulation (JIC) and increased primary zone volume for better NO_x control without loss of fuel economy. In simulated tests, the JIC-4 shows 0.5 HC, 2.6 CO, and 0.33 NO_x g/mile emissions.

heat losses. Once found, it's not so hard to deal with them.

As for component efficiency, that's an exact science with NASA now. Raising turbine and compressor efficiency to meet EPA goals won't be difficult. It may be possible to go considerably further.

We asked Thur if adding up all the percentage gains in fuel economy is truly justified. Do they not overlap, or reflect dual benefit from a single modification? He replied: "There are things I did not show in the table that interact in the wrong direction. The total value when we add up all plus factors is 60-65 percent, but we discount some of them because of interactions, so our 50 percent gain is net gain."

Not shown in the table are improvements in accessory drives. "They are getting only 30 to 40 percent efficiency in the alternator, the fan works at only 35 percent, and the pumps are very inefficient," Thur explained.

What about cost? "I am convinced the turbine can beat the pis-

ton engine in cost," said Sam Williams, inventor of the gas turbine that powers the experimental AMC Hornet on test by New York City. "That means developing some automated processes, but only in line with new tooling as normally developed by auto companies."

Chrysler's Huebner explained: First attempts at mass-producing turbine parts will probably not be the right way. If we tooled up for it today, the machine-tool industry would make such fantastic progress in the next few years, we'd have to retool half the line. The only critical thing in the engine is nickel—not a rare metal, just expensive. A turbine wheel weighs about 1.4 pounds and five percent is nickel."

A Williams Research study shows that nickel turbine wheels can be made for \$9.44 apiece (in a production of one-million units).

Will Chrysler rush to get the 7th-generation turbine into production? We asked Huebner for the facts: "On a crash basis, we could have limited production in about four

years. After 18 months field experience with those turbine cars, we'd order high-volume production tooling—delivery in another 18 months. We'd be ready to launch an automated line in about four years from the time we started limited production. It would take about two years to get such a plant on-stream. So to get into mass production from point zero, would take about 10 years."

The turbine and you. No matter how you feel about clean air, you'll see the advantage of burning less fuel (and cheaper fuel—EPA test turbines run on JP-4 jet fuel). What else will the turbine car offer you?

You get a lightweight engine, which translates into a lighter car. Bulk is about that of a medium V8.

You get a quiet, vibrationless engine with fantastic durability and high reliability. The cooling system is eliminated and there are no cold-start problems. A simplified maintenance schedule is indicated.

This could be the auto engine of the future. We'll probably know for sure in the next 30 months. **PS**

New geological evidence shows How Diamonds Rocketed from

Fields of gems were born with a shriek, scientists now hold, as erupting jets of gas hurled precious stones up through primeval "pipes" to the surface

By ALDEN P. ARMAGNAC
ILLUSTRATION BY DEAN ELLIS

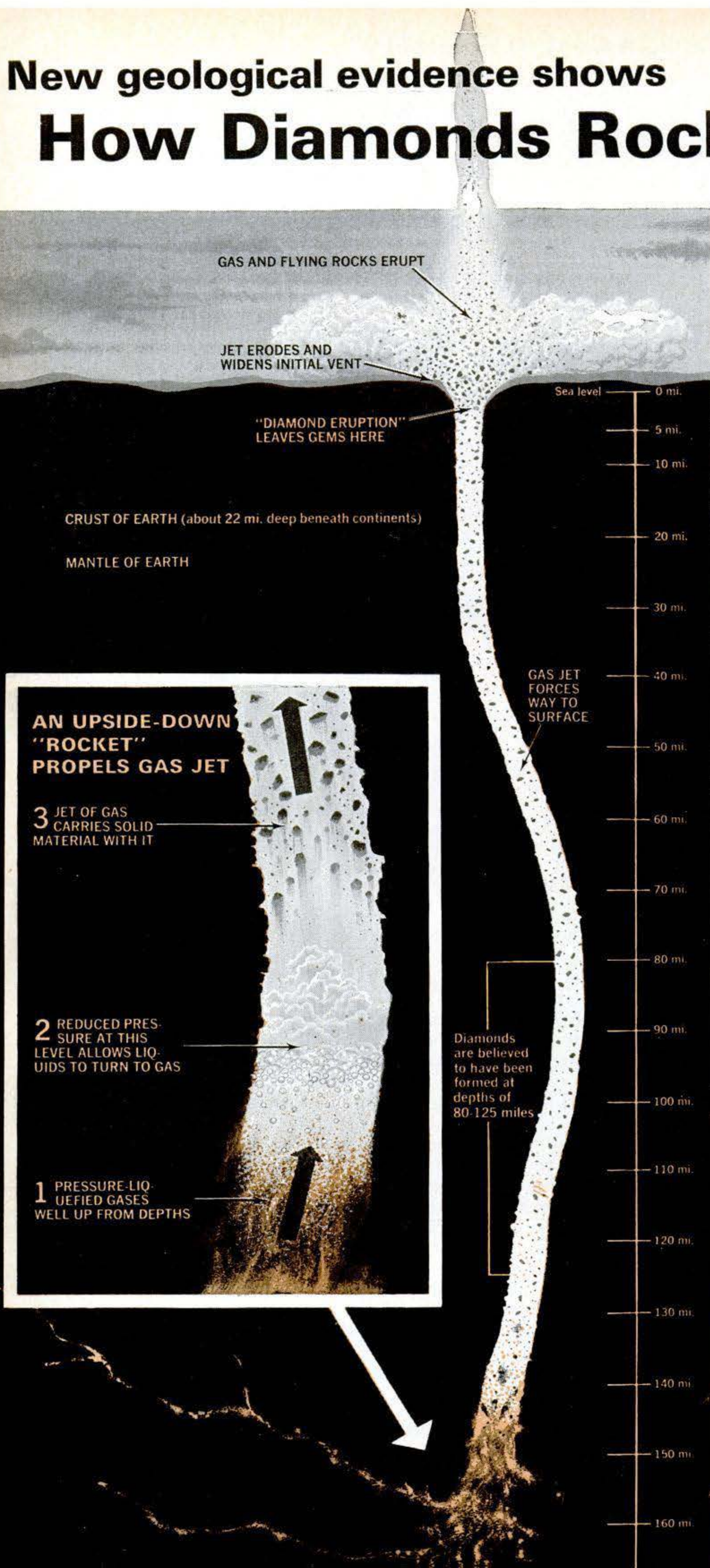
The ground heaved and went flying. From the rent earth an awesome jet of vapor shot into the sky, with a shriek like steam from a million broken high-pressure mains. Down again from the billowing cloud rained rocks and mud.

Before the weird eruption ended, the eroding jet widened its orifice to a funnel-shaped crater probably more than 1000 feet across in the sandy, treeless African plain. The opening filled up again, with rocks falling back into it or with material that didn't quite clear the vent. In time, the debris became cemented into solid rock. Millions of years later, men probed the curious formation—and found diamonds, of fabulous size and value.

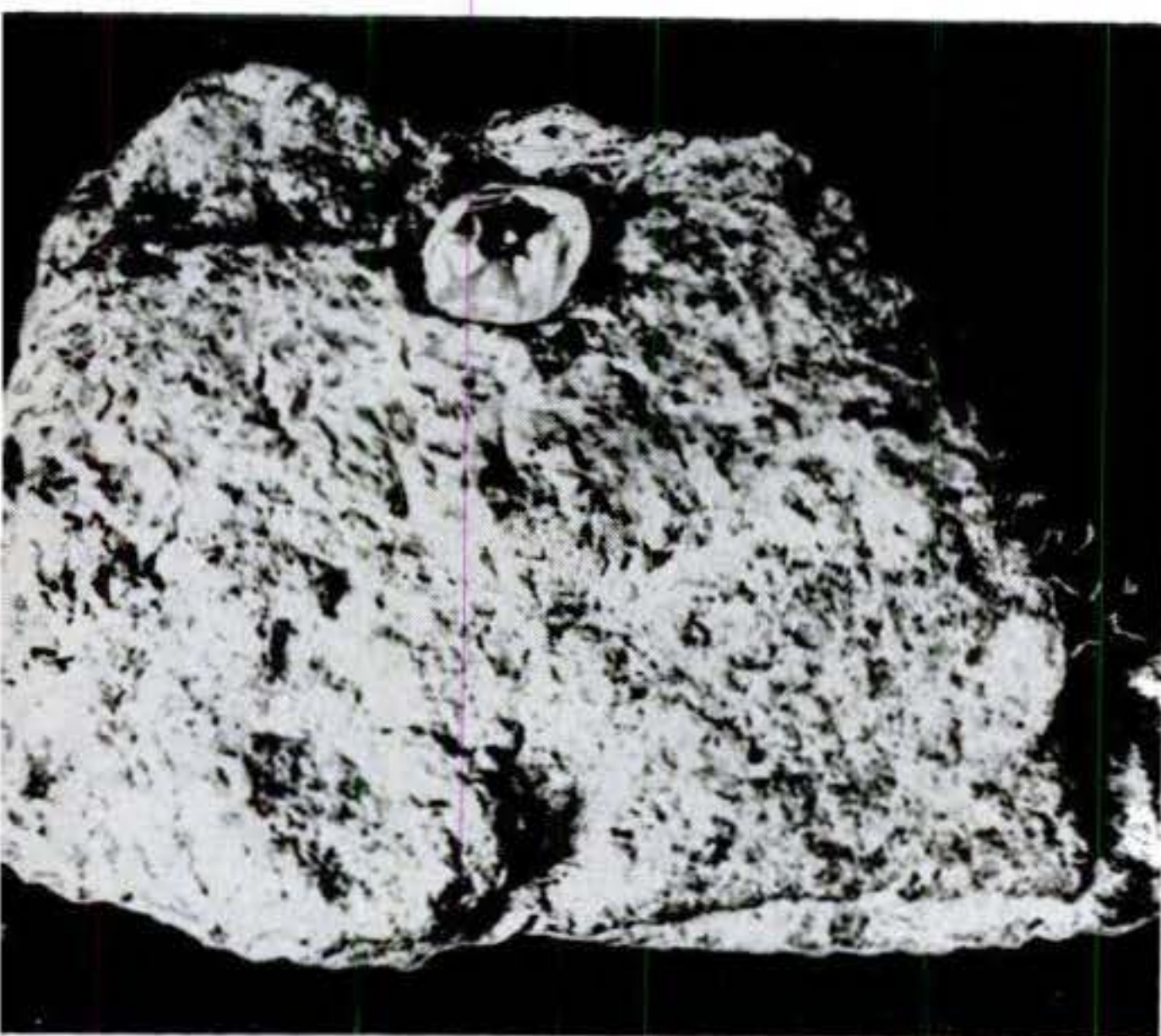
That is the way the world's diamond fields were born—in Africa and wherever else the gems have not been carried far from their original sites by streams—according to a new theory advanced by Dr. Thomas R. McGetchin, Massachusetts Institute of Technology geologist. Other U.S. scientists have lately been turning up fascinating bits of evidence supporting it.

Gems from depths. Nature's diamonds, it's been known, must have been formed 80 to 125 miles deep, in the region below the earth's crust called the mantle. Only at this depth could they have undergone the fantastic pressure and great heat needed to turn plain carbon into crystalline gems. But how the diamonds got to the surface where they could be mined has been a mystery. Here is the story as Dr. McGetchin sees it:

Beneath the African continent some 120 million years ago, a strange sort of fluid began making its way up from the depths. It consisted at least largely of water and liquid hydrocarbons, heated far past their normal boiling points but prevented

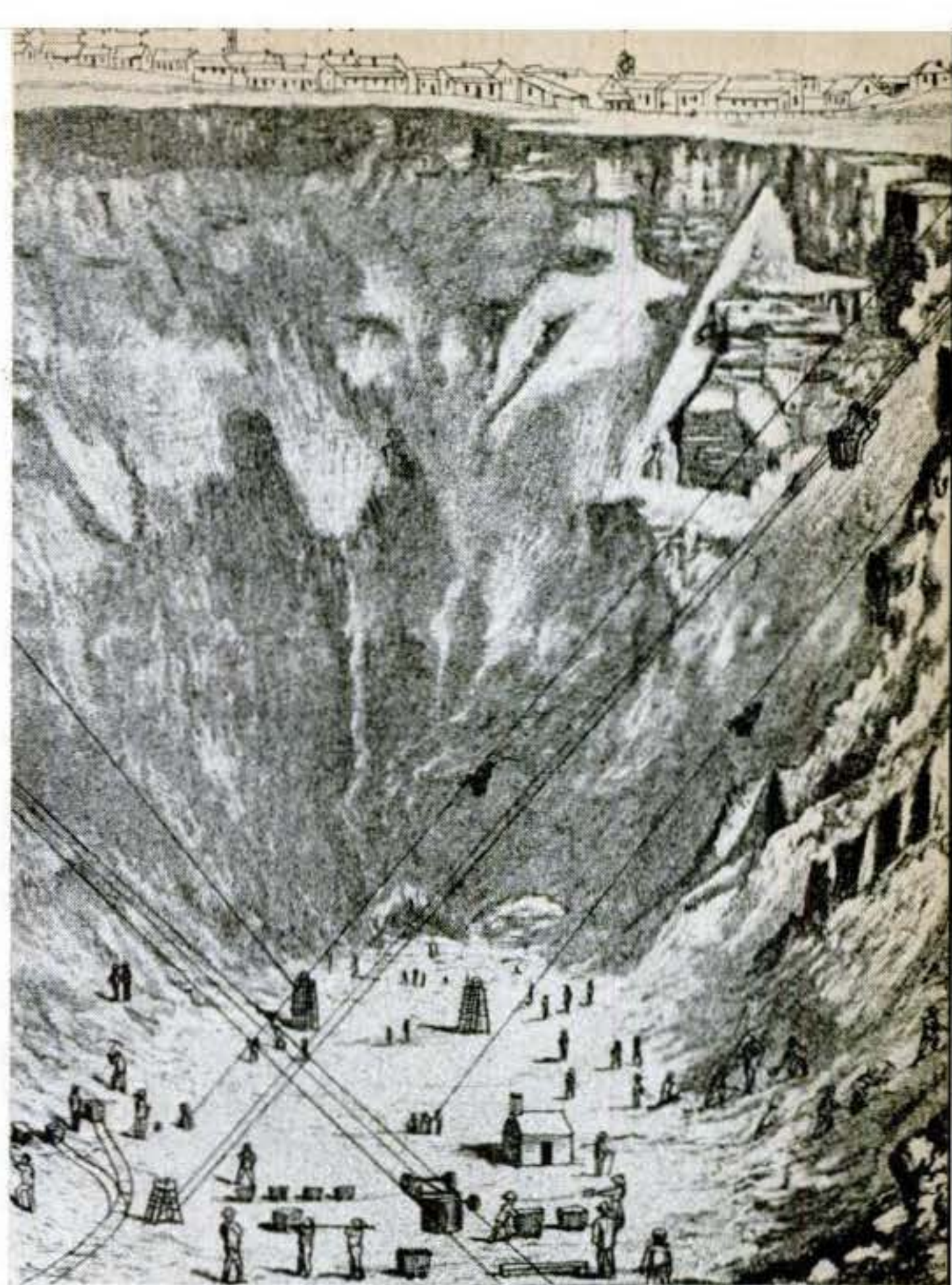


the Earth's Depths



Kimberlite matrix is nature's setting for a rough diamond (left). Formed deep in earth under terrific pressure and heat, gems are now thought to have been borne to surface by an eruption of gas.

Diamond mine at Kimberley was open pit in 1870s before shafts went deeper. Excavation pictured in this old PS engraving may well indicate the size and shape of the original prehistoric blowhole.



from turning to vapor by subterranean pressure.

An underground "rocket." As the hot liquid welled up, pressure on it fell with diminishing depth, until suddenly it was able to flash into vapor. Then, as if from a gigantic upside-down rocket, a mighty jet of gas erupted upward. Nothing could resist its force. Rocks shattered, yielded a passage. Slowly at first but gaining speed, the ascending gases broke through to the earth's surface, to reach supersonic velocity.

Swept along in the blast was rock from every level. Flying pieces knocked off more rock from the walls of the tubular passageway. What came up could well have been samples of the earth's interior all the way down to perhaps 125 miles.

Diamond pipes. Thus, the theory holds, were formed nature's diamond-bearing "pipes" filled with "blue ground"—the mineral kimberlite, natural matrix of diamonds.

African diamond mines began as open-pit workings. Since diggers followed the diamonds, quite possibly the early excavation may outline the shape and extent of the original gas vent. In later years, mine shafts probed the pipes deeper.

Africa has no monopoly on kimberlite pipes. Similar ones in the United States have yielded diamonds up to the size of a 40-carat gem from a mine (no longer operating) near Murfreesboro, Ark. Its site became a tourist attraction where, for a small fee, visitors could hunt diamonds and keep any they found. In 1957 a lucky lady rockhound

came away with a three-carat stone.

Microscopic bubbles of foreign substances trapped in natural diamond crystals support the new theory of diamond fields' origin.

Clues from bubbles. Analysis shows the bubbles contain a variety of things as unlikely as water, methane (marsh gas), and ethyl alcohol, and proves they were present at the depths where diamonds were formed. That can amply account for the vapors that brought them up.

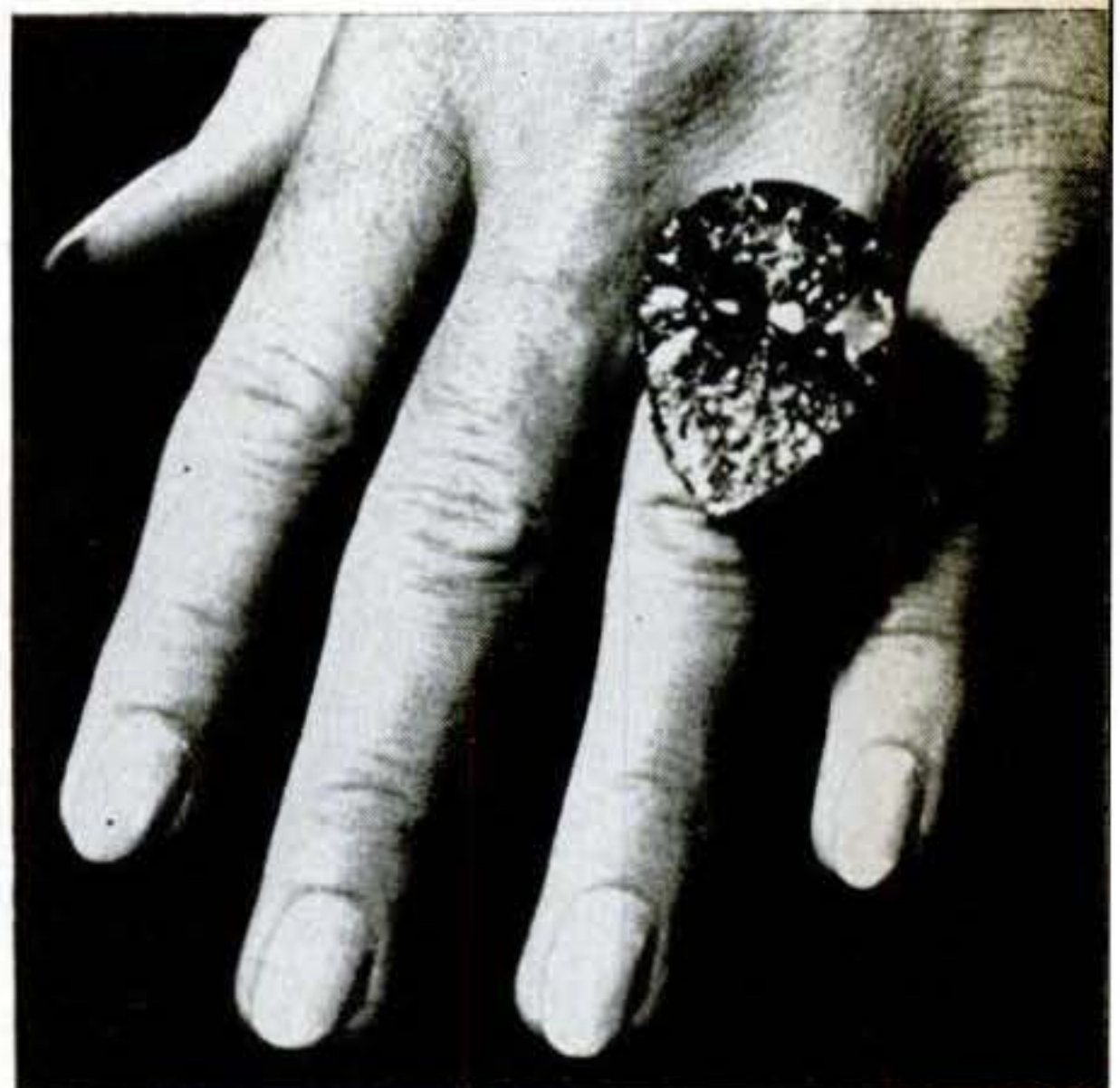
Like compressed air released from a tire valve, Dr. McGetchin suggests, the superhot ascending gas was cooled by expansion. That would explain the long-puzzling fact that beds of coal show no sign of being burned or scorched by kimberlite pipes piercing them—and coal is sometimes embedded, unaltered, in the kimberlite.

Some diamond-bearing kimberlite rocks, and even the ultrahard rough diamonds themselves, are rounded—like beach pebbles—as if by abrasion. This is regarded as strong evidence that the diamonds had a long rough ride to the surface—and again backs the theory that a high-velocity jet carried them up.

Eruptions of gas from comparatively shallow depths of the earth have occurred within recorded history. But the mighty jets pictured by Dr. McGetchin, coming all the way up from the deep mantle, probably never have been witnessed by man. Some suspect they may have been triggered by the straining force of shifting continents, millions of years before men came along. **PS**



Fabulous 726-carat Jonkers Diamond discovered in 1934 yielded this gorgeous array of gems when it was cut.



Million-dollar Cartier Diamond went into ring bought for Elizabeth Taylor.

A Dozen New Craft from the PARIS AIR SHOW

Huge supersonic transports grabbed the headlines, but some exciting new craft hidden at Le Bourget Airport had interesting designs

By BEN KOCIVAR / *PS Consulting Editor, Flying*

The giant biennial Paris Air Show is an ideal platform for launching trial balloons. This year's 30th was no exception. Shown here are some of the aircraft I found interesting.

The big news with all planes was noise pollution. Big craft, including the supersonics, are being pushed to "whisper" their way in and out of big airports if they are to be unrestricted by takeoff and landing curfews ["How Science Is Stealing the Thunder of Those Noisy Jets," Dec. '72.] Smaller ones, including the short-haul 40-and-more passenger versions, face even more stringent rules on noise because they are being designed to use very small airports with short strips close in to the communities they serve.

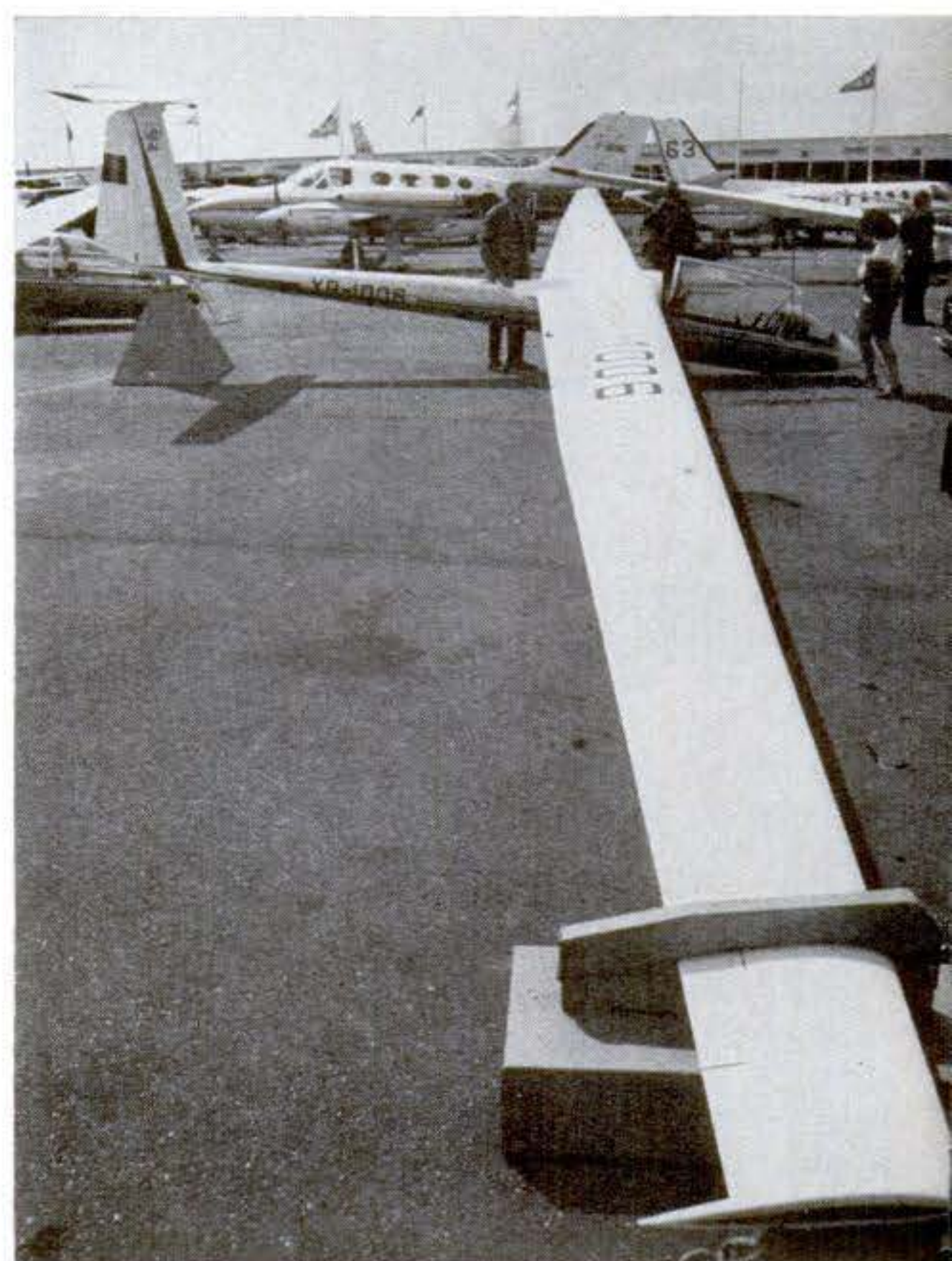
A new quiet airliner called the Europlane is being developed by a consortium of British, Spanish, Swedish, and German companies. It will cost about \$13 million, carry about 200 passengers and is expected to be in service by 1979. Two turbofan engines, mounted high on the rear fuselage just over and slightly behind the wing, use the trailing edges of the main low wing as a shield to keep noise from reaching the ground. The Europlane will have a 500-mile range using 4000-foot runways and a 2300-mile range with 5500-footers. Its 40,000-pound-thrust engines will provide a "new order of quietness," according to the proposal.

Noise goes down but the prices go up. The cheapest glider kit shown was about \$4500, and even small powered planes hardly got lower than \$40,000. High prices have increased interest in homebuilts. An organization with information on hundreds of amateur designs is the Réseau du Sport de l'Air, 39 Rue Sauffroy, 75017 Paris, France.

Unfortunately at the time of the show, the crash of the Soviet SST, the TU-144, was what made the biggest headlines. (The cause of the accident is still not known at this writing.) Experts say the catastrophe may bolster a big drawback on the future acceptance of already-controversial SSTs. [9]



Counterrotating rotors with coaxial drive on this German HTM three- or four-place Sky rider eliminate need for tail rotor. The 269-hp reciprocating engine provides load-carrying capacity on a par with turbine engines for less cost.



All-metal single-place IS-29G sailplane built in Romania appeared well-finished. The competition design features a tall-T tail, retractable landing wheel, big bubble canopy, and long, narrow 56-foot wing. Speed? Reports say 41 to 138 miles an hour.



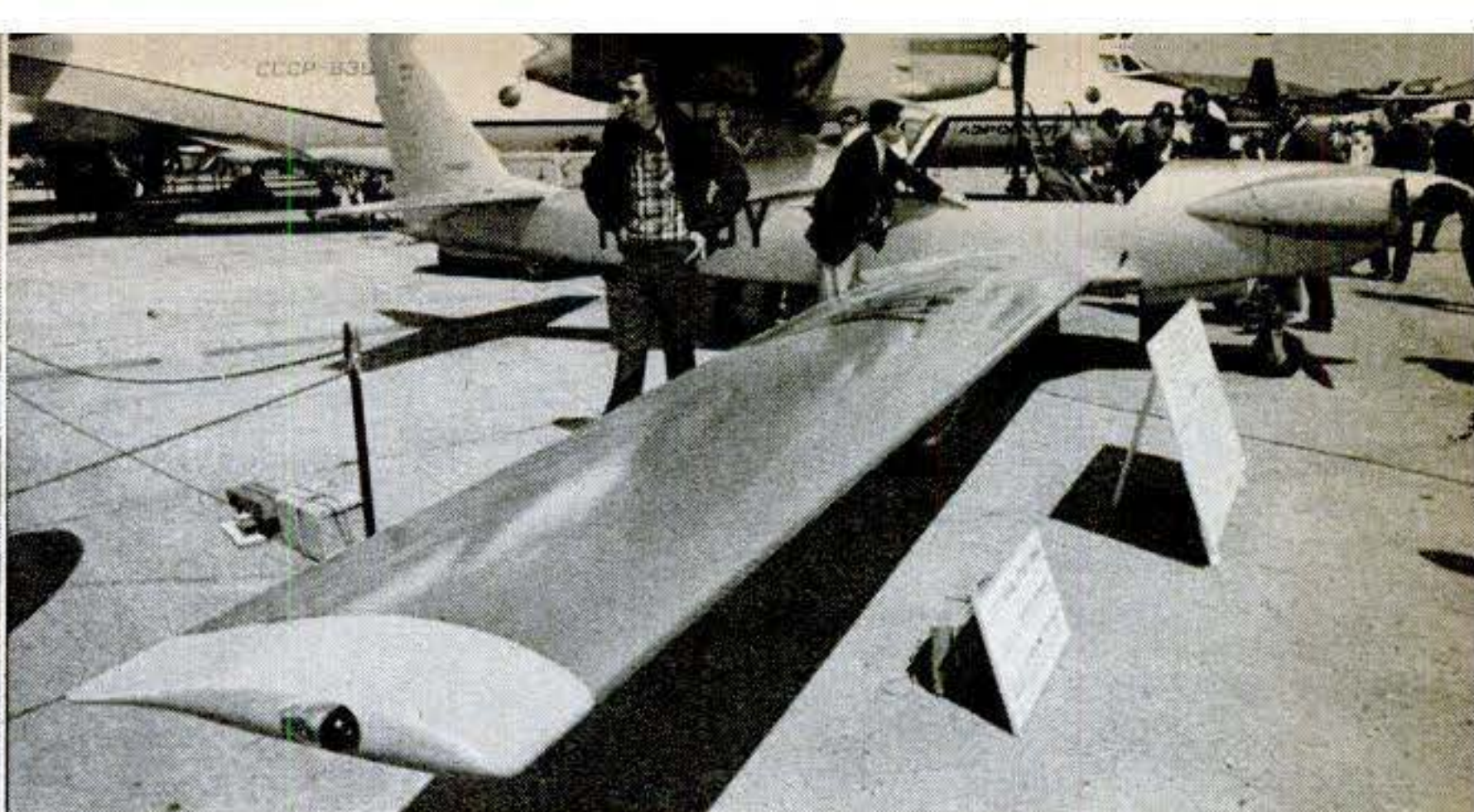
VFW-Fokker 614 short-haul transport has two turbofans mounted on high pods over the low wing. Unusual engine placement allows less noise on the ground, less chance of engines sucking in debris from rough fields, clean wing with full-span uninterrupted flaps, and less landing-gear weight. Craft is expected to be flying with passengers by 1975.



French Robin four-seat HR-100 Tiara is company's first retractable-gear model featuring sliding canopy. Rolls-Royce Continental 285-hp engine powers it at 193-mph cruise speed. Range is 1400 miles with three passengers. Price: about \$50,000.



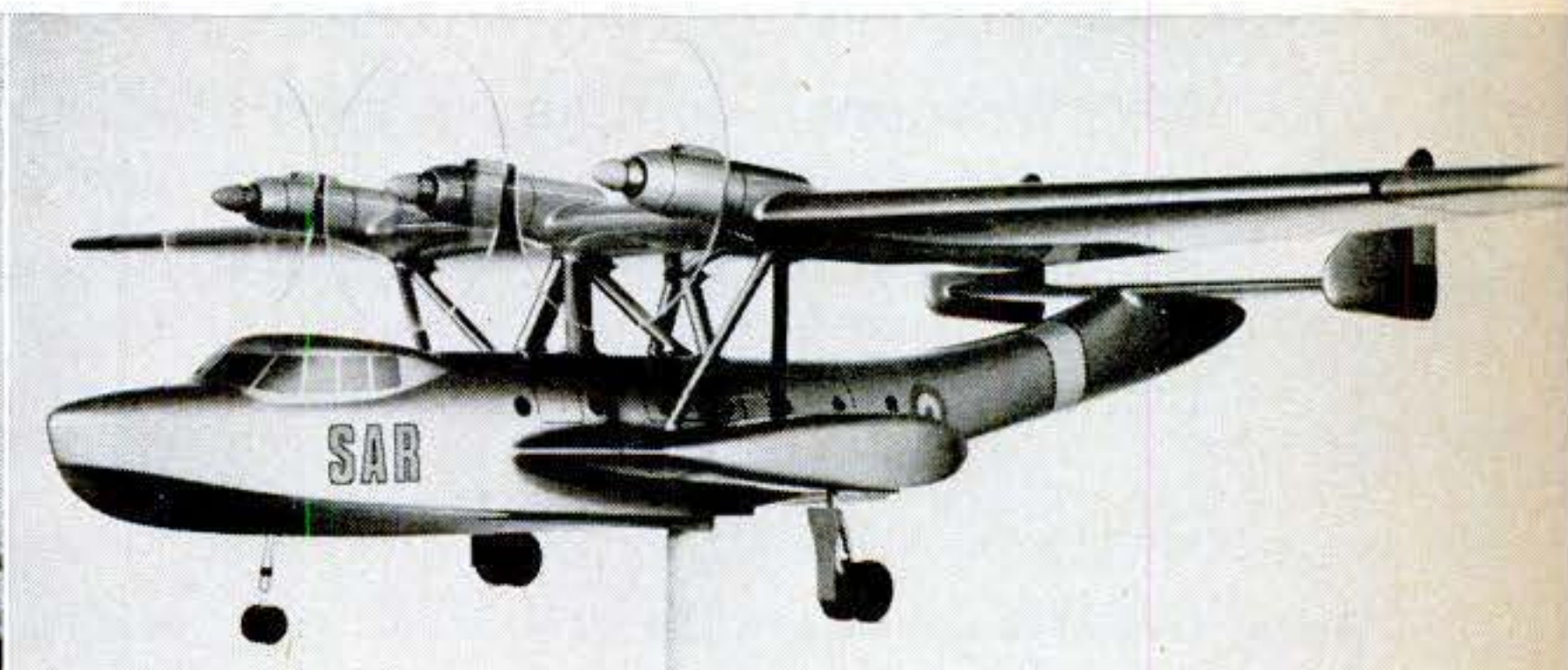
A gyroplane, the prototype Campbell Cougar is being developed in a single- and two-place version. Overhead rotor is 27½-foot aluminum blade. The 130-hp engine also drives the pusher prop. Specs claim 650-pound craft has 225-mile range, 75-mph cruise speed, and 24-mph landing speed.



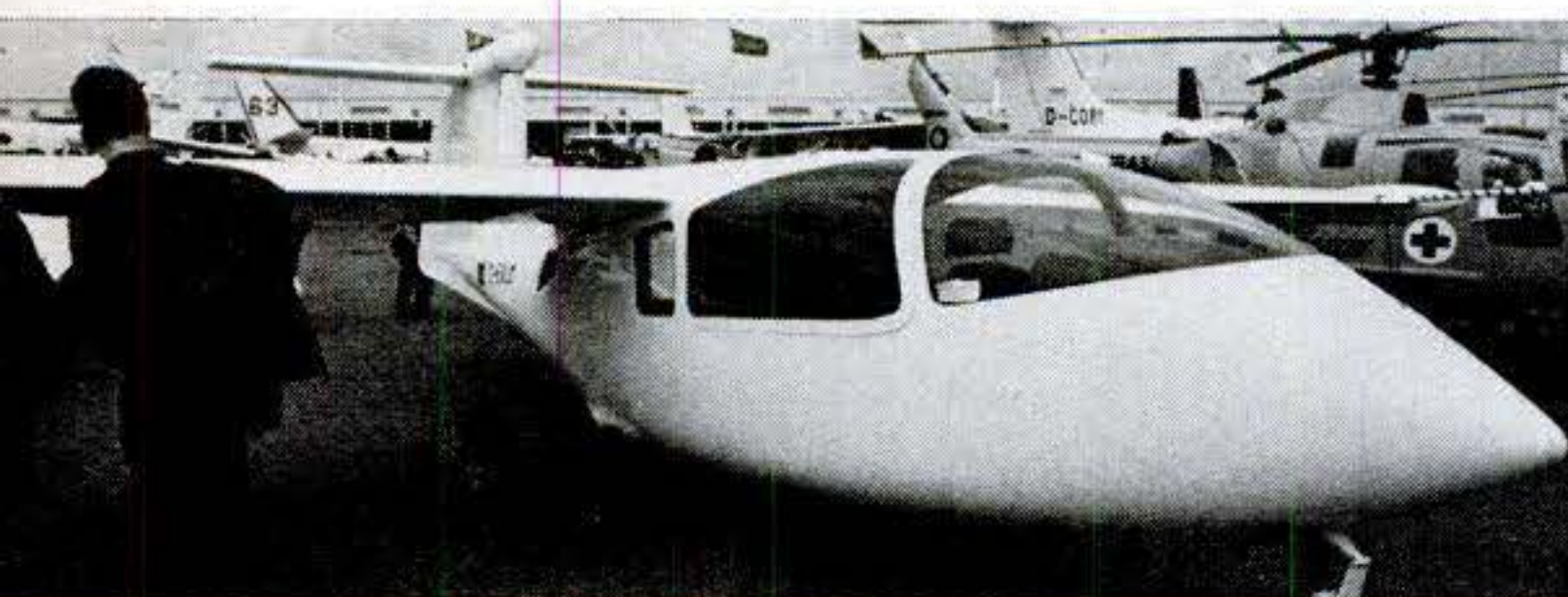
Tandem two-seater RF 8 Fournier is sophisticated all-metal trainer with power-glider characteristics. Price is about \$40,000 and makers hope to sell it to French Air Force. Powered by 125-hp Lycoming engine, it can be glided with power off. Craft is fully aerobatic; has retractable gear.



New Nomad 22 is Australian turboprop STOL with wide retractable landing gear. Carrying 12-13 passengers, it can cruise along at up to 200 mph; has 1000-mile range. Craft has full-span double-slotted flaps. Low-speed lateral control is provided by wing-tip spoilers when flaps are down.



Proposed Dornier Do. 24/72 is updated turboprop version of three-engine seaplane first built in 1935. Wheel pods make 40-passenger craft amphibious. It'll be used for search and rescue and coastal patrol in rough seas. Giant 91-foot wing-span amphibian would be made in Spain and Germany.



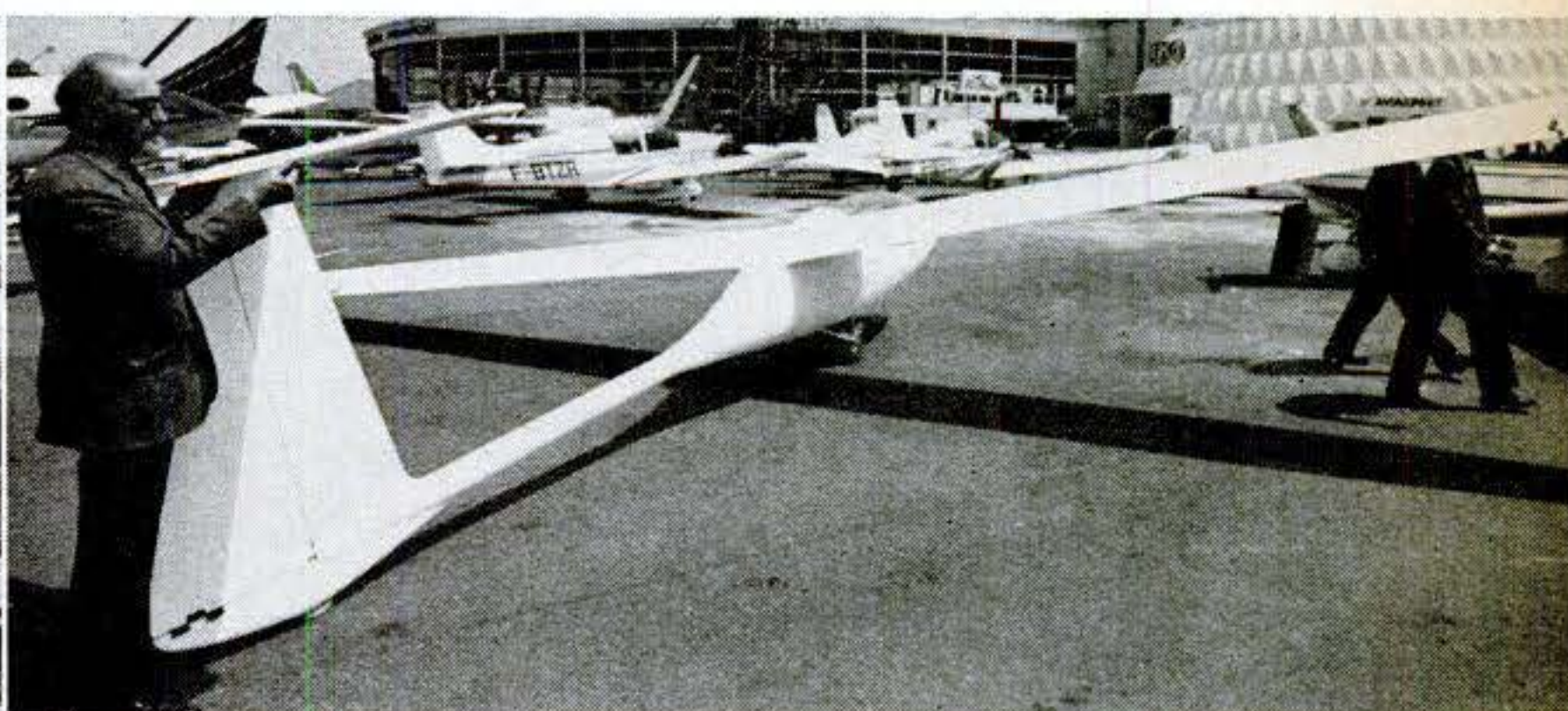
Tractor prop mounted on front of rudder fin is unique feature of prototype Poschel P-300 Equator STOL amphibian with watertight fuselage. This epoxy-resin and glass-fiber ship is powered by 310-hp Lycoming engine located behind pressurized cabin. Prop is powered via extension shafts.



Single-place competition aerobatic aircraft of classic design has fixed wheel pants, tail-dragger gear. Used by the French Air Force, the CAP-20 cruises at about 70 mph, is stressed for eight positive g's and six negative g's. Price is about \$40,000. A two-seater version is also available.



Rockwell Commander 112, only new U.S. small plane exhibited at the show, has wide cabin with two doors. Unusual retractable landing gear with trailing beam suspension makes for soft touchdowns. Base price is about \$25,000. Equipped for instrument flying, craft's price goes up to \$32,000.



Single-place Planeur BMI comes in kit form. Wing spars are wood, skin fiberglass or epoxy, and kit price—about \$4500—includes fabricated metal parts. Prototype had rough-skin finish but was not yet certificated. Wingspan is 48 feet. Craft has modular construction for easy repair.

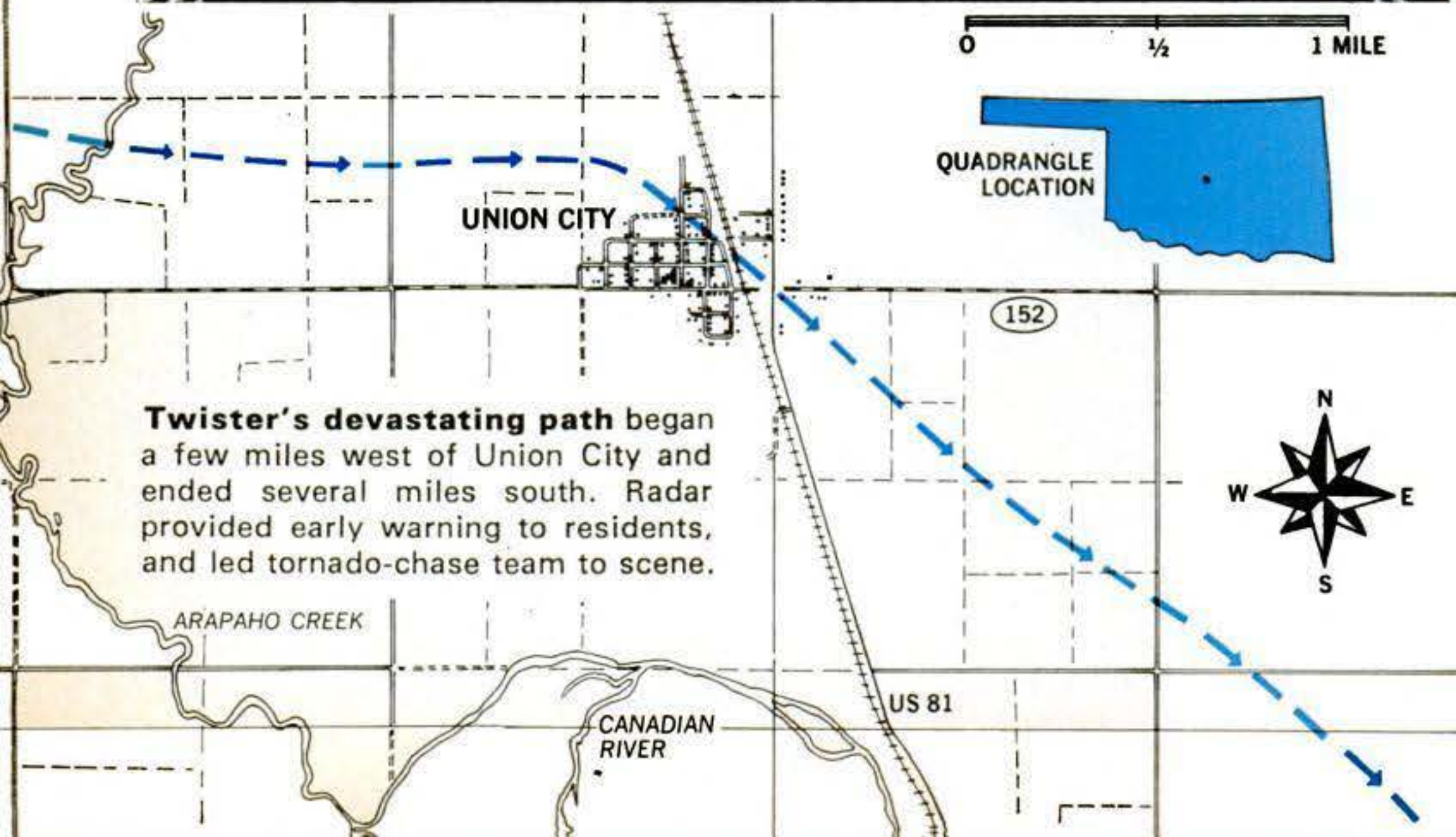
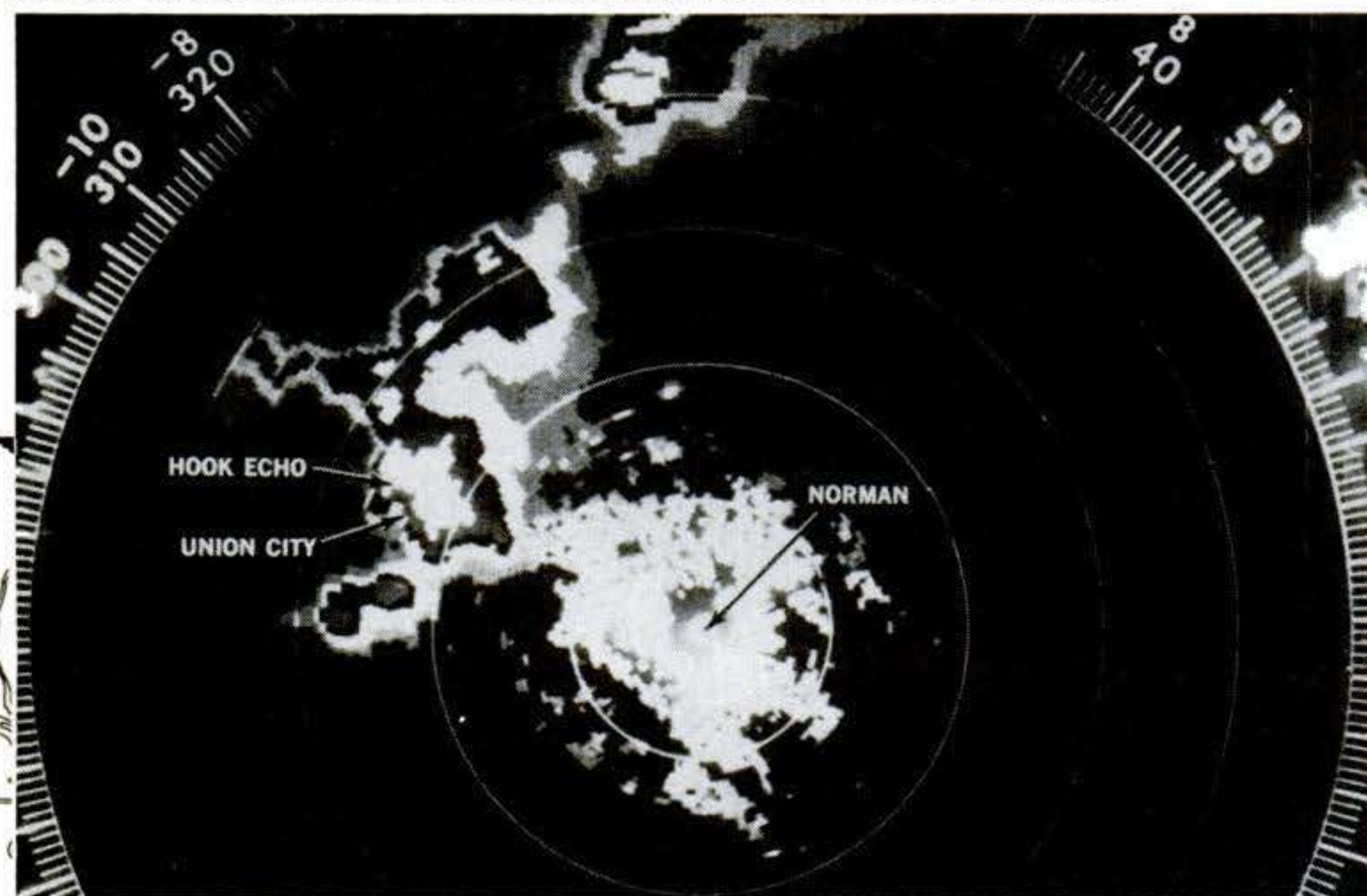
TORNADO!

How Science Tracks Down the Dread Twister

New weapons—computers, satellites, special radar and detectors—spot twisters early and help scientists solve the mysteries of their development

By ROBERT GANNON DRAWINGS BY CHARLES BERGER

Radar screen revealed a twister's "hook" pattern 10 minutes before it ripped through Union City, Okla. Each circle on screen represents 10 miles.



Twister's devastating path began a few miles west of Union City and ended several miles south. Radar provided early warning to residents, and led tornado-chase team to scene.



Tornado-chase team hurriedly sets

The ambulances had gone now, and the fire trucks—unnecessary after all—had returned to the neighboring towns. Red Cross people were setting up beds in the high school, police were cordoning off the area, and as dusk began to settle in, an army of utility people were trying to wire things back together.

The frantic emergency was over, and finally I had time to think back on what really had happened.

At 4:58 on the afternoon of May 24th, a tornado tore into the tiny Oklahoma village of Union City. A half minute later it left. Where some 40 homes and businesses once stood, a junkyard remained.

Five people were hospitalized, 71 houses damaged or destroyed, a grain elevator was flipped over, and a dozen mobile homes vanished.

"Tornado alley." I was there because POPULAR SCIENCE had sent me to Oklahoma to find out about tornadoes, about the research going on into what makes them work. I wanted to see one, of course, but never figured I'd be only three miles from a twister when it wiped out a town.

The Department of Commerce's National Severe Storms Laboratory—the most impressive collection of tornado experts and equipment in the world—is in Norman, Okla., in what's called "tornado alley." Although twisters have struck in all



up equipment after two-way radio directs them to twister. Funnel was 2.5 miles away with a half-mile-wide tip.

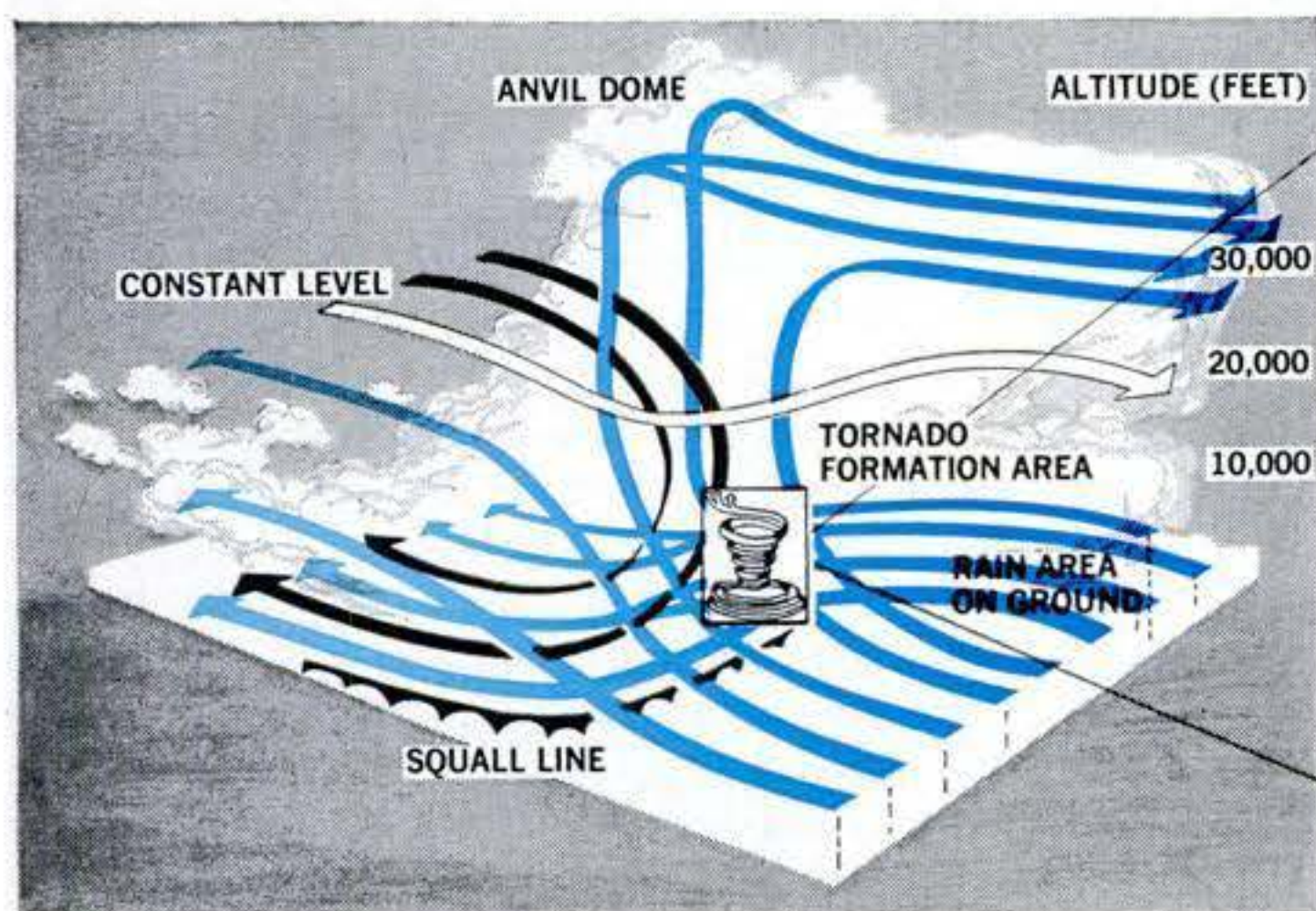
states, they're most common in a Midwest zone stretching from Texas to Wisconsin, with a secondary swath cutting across the deep South. Texas and Oklahoma get hit by the twisters most.

"We were set up to study severe storms—tornadoes almost always are spawned from thunderstorms—and to improve methods for early detection of them," explains director Edwin Kessler. "We study them in the

spring, when most tornadoes occur, then spend the rest of the year figuring out what we saw."

New science tools. Essentially, four new weapons are being em-
Continued

How Nature's forces combine to create a gigantic whirlwind



Collision of contrasting air masses—cool, dry air with moisture-laden warmer air—creates conditions under which tornadoes can form (left). Precisely how they are generated is unknown, but many scientists believe a combination of *mechanical* and *thermal* forces are involved (right). When external forces restrain slowly revolving

currents of air, rotation speed increases as the radius of rotation is decreased (just as skaters spin faster by drawing their arms in). A tornado vortex may also form when cool air overrides warm air and the imbalance forces the warm air rapidly upward in a rotary pattern. Depending on conditions, thermal or mechanical forces may dominate.



Churning bulge grew into a tornado as the chase team scrambled to gather data. Moments later a funnel developed.



Chaff-bearing rocket is readied for launch. Metal chaff dispersed near twister helps scientists locate it with radar.



"That's Union City going up! I live there!" Seconds later, this farmer jumped in his pickup and sped toward the twister.



Sheet metal wrapped around a pole is examined by author. Storm hospitalized five of Union City's population of 306.



Tornado's enormous power turns harmless objects into missiles. Gannon spotted coat hook, nail, driven into trees.

ployed to spot and study twisters:

- **Doppler radar.** Ordinary radar can see if a rain cloud has formed, but can't tell much about what the storm winds are doing. But Doppler radar, because it can detect speeds of approaching or retreating objects, can indicate the direction of tornadic winds—and soon, hopefully, even their speeds—by determining motions of raindrops.

- **Detectors.** Researchers recently discovered that tornado-producing storms fire off bursts of electromagnetic impulses—as many as one every three seconds—detectable by receivers tuned to 3.16 MHz. Whenever such a "signature" occurs within 50 miles of its antenna, a detector announces it. This year, 15 detectors are listening from Nebraska to Florida, and are expected to catch 75 percent of nearby tornadoes. If this year's network proves as useful as hoped, such early-warning sensors could eventually be located in every city in the tornado belt.

- **Weather satellites.** A new satellite positioned above the equator can now take photos of the whole continent every 13 minutes. The old model provided only one shot a day. Storms now can be tracked as they develop.

- **Computers.** With weather data from the last 20 years stored in their memories, computers compare what is happening now with whatever has happened before and come up with highly reliable forecasts.

Tornado forecasts. Even now, before such equipment and techniques are operational, prediction records have been impressive. In the last 20 years more accurate forecasting has lowered the annual death toll some 50 percent; and today, if the Weather Service says there may be a tornado, 40 percent of the time there is. Fully three-quarters of the big ones are caught.

When detailed mechanics of tornadoes are finally revealed, weathermen expect their tornado prediction ability to be spectacular. And then they can attack the complex problem of how to break them up before they become killers.

"We have an immense way to go," cautions Kessler. "Nevertheless, we know an awful lot more than we did just a few years ago and with some new equipment just going into use, we're right on the edge of some major insights, I feel."

The basic statistics about tornadoes are well known: They kill an average of 125 people a year, injure a thousand more, do about \$75 million in damage. The U.S.—top tornado producer—spawns nearly 1000

[Continued on page 122]

What to do when a tornado is coming your way

Best hiding place is well-ventilated cave or cellar with reinforced roof. Otherwise:

- At home, open downwind windows; hide in basement near windward wall (usually southwest or west) or first-floor bathroom or closet, or under heavy furniture. Stay away from windows, mortar walls, chimneys.

- In office building, go to lowest-floor interior hallway or bathroom. Shun large rooms.

- In schools, follow an advance plan to an interior hallway on the lowest floor. If building does not have reinforced construction, go to a nearby building that does.

- In cars, drive at right angles to storm's direction, if there's time. Otherwise, get out and crawl into culvert, or lie face down in ditch with arms over head.

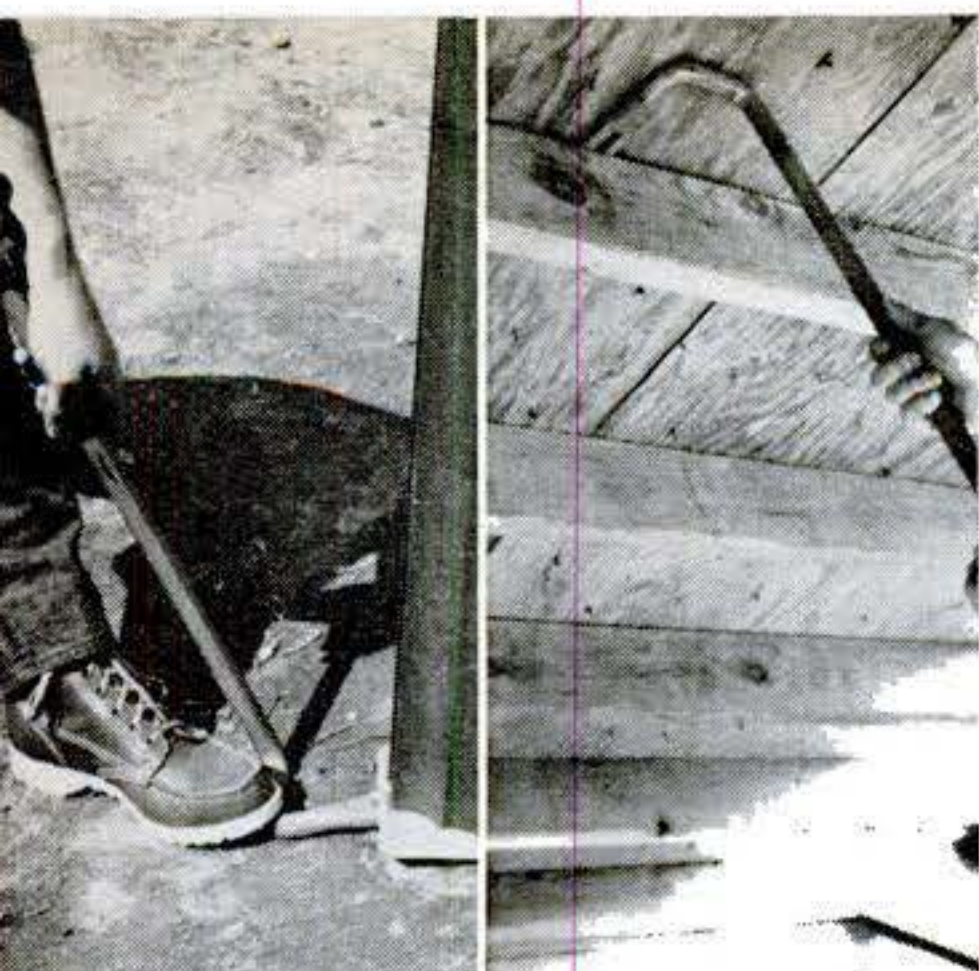
House construction can help.

- Mobile homes should be tied down with concrete-anchored cables.

- All houses should have sills well bolted to solid, deep foundation, and studs with plenty of nails in them.

- Vent attics and top-floor ceilings.

For tornado shelter construction, send 30¢ to U.S. Govt. Printing Office, Washington, D.C. 20402 for Dept. of Commerce's booklet number NOAA/PI 70007, *Tornado*.



Straight lifts are a cinch with the new twist crowbar. Above-ground pool column (left) is raised to replace washed-out soil. Try removing beam with ordinary crowbar. Proper bite often hacks up plywood, but Sweetie-Pry's offset end fits.



Crowbar with a New Twist

They call it Sweetie-Pry. It's a combination crow-, wrecking, and lifting bar that comes with one end bent 90 degrees toward Alaska, the other 90 toward Hawaii, giving it a dog-leg or bellcrank for use in otherwise inaccessible locations. The opposite end is pretty much like a conventional crowbar. Both ends are worked for pulling nails.

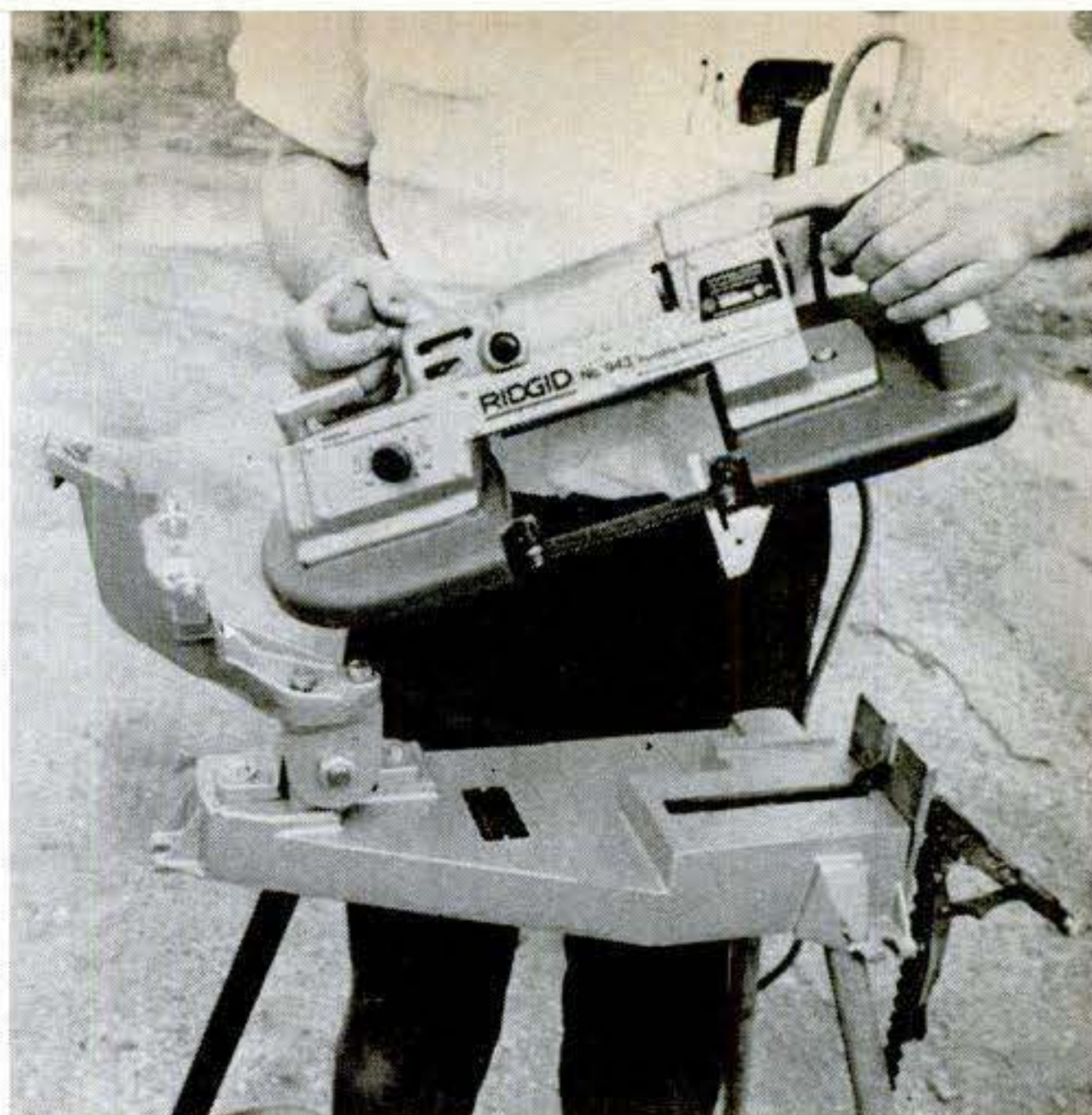
Although the bar is designed especially for construction workers, it's a fine do-it-yourself tool. Because of the right-angle handle, it's great for lifting furniture and appliances, providing a straight lift. For correcting errors in framing walls, floors, and roofs, its twisted leverage lets you pry pieces apart without tearing them up. I used it for everything a conventional crowbar could do and more.

The Sweetie-Pry comes in three sizes from 17 to 37 inches long. (The one shown in the test photos is a 27-incher.) Prices are \$9.95, \$14.95, and \$16.95. It's from J.D.F. Enterprises, 712 Dunn Way, Plantencia, Calif. 92670.—*Richard Day*

PERSONAL-USE REPORT

The Bandsaw You Carry with you

Heavy-duty industrial motor and handle are coupled directly to two bandsaw wheels, worm-drive power train.



What the hand-held cutoff saw is for a carpenter, the new Ridgid portable bandsaw promises to be for anyone with metal to cut. Except that when you mount it on its stand, the bandsaw also does what a table saw does in woodworking. Actually, you get two saws in one, and the more I used it, the better I liked it.

Your first impression is that here's one of those ideas that might work—or might not. Pick it up and you gain confidence.

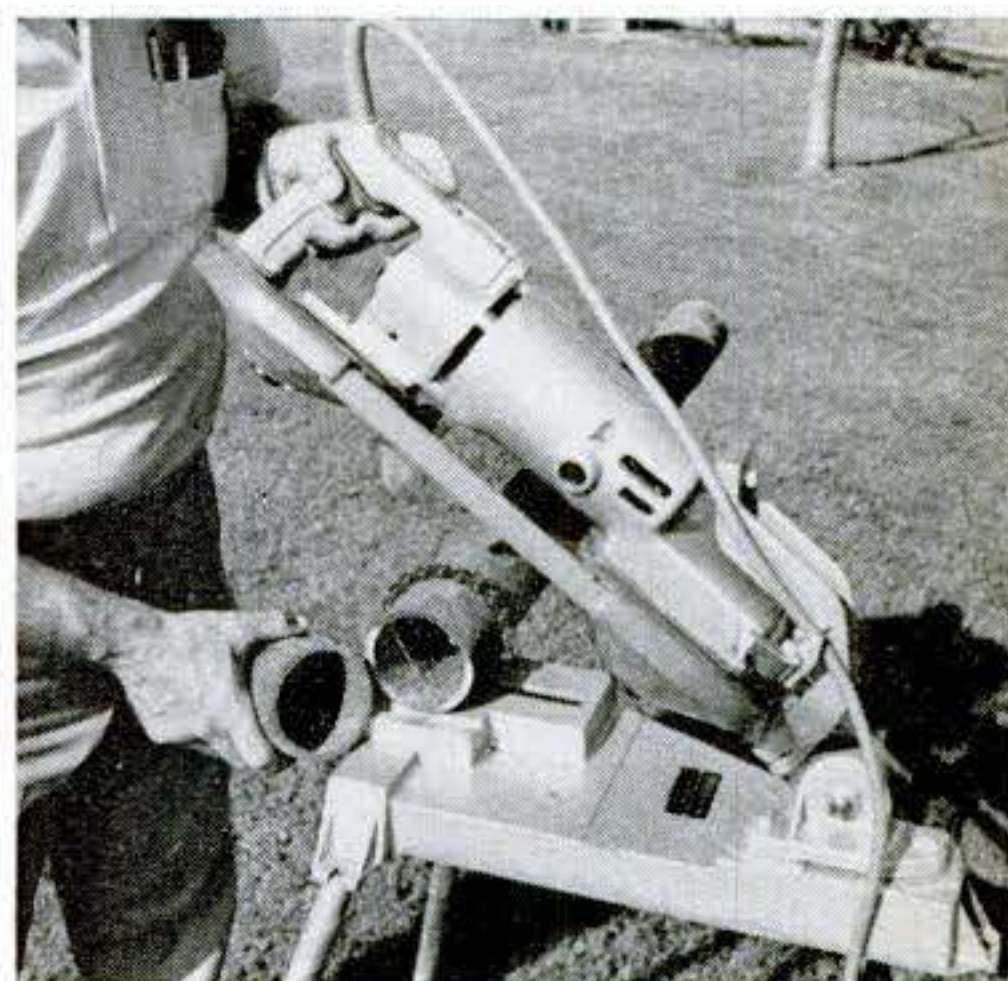
When you squeeze the trigger and lower the blade against a piece of steel, none of the expected fight and buck appears. Cutting action is, of course, in one direction, and the blade sinks through steel as if it were cheese.

My tests proved you could cut almost anywhere you can take the saw—under a car or down in a boat hull, for example. But to justify its cost, you'd want to keep it busy in the shop as well.

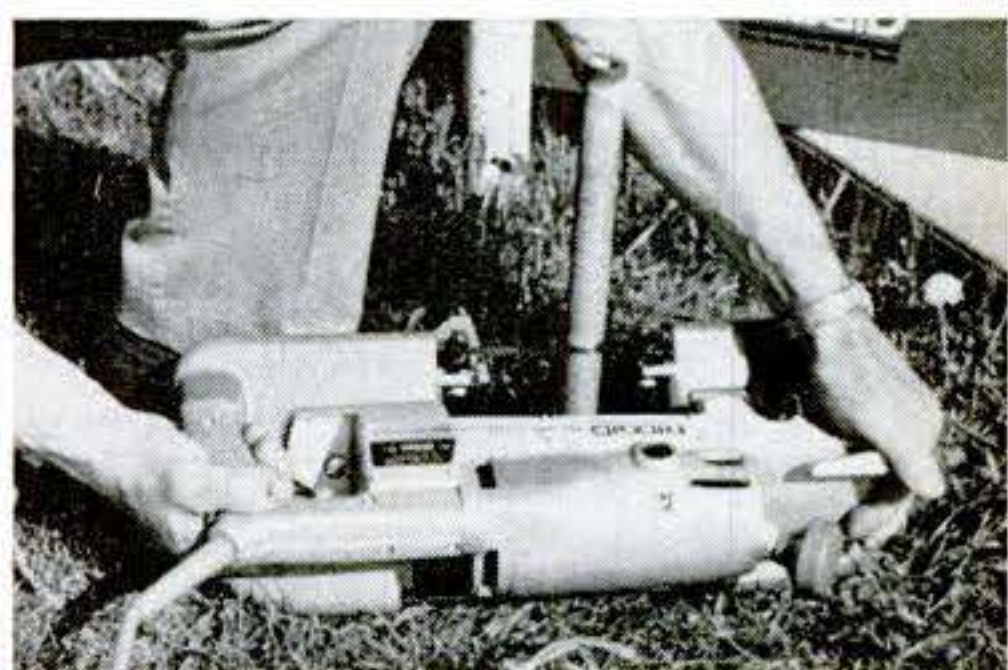
You can mount the stand on a bench, or buy three plain pipe legs and put them in the sockets on the stand. You also must square up blade and stand to cut true. The front hand knob unscrews and a bolt threads in to mount the saw on the stand's swinging arm. Once set up, guides control remounting so it's always square.

A two-inch bar of bronze looked like a good test. At first, cutting action didn't seem quite right, but a few twitches of the blade-speed control tuned in the proper speed and the blade sank in with just the weight of the saw (17 pounds). Speed control is an option.

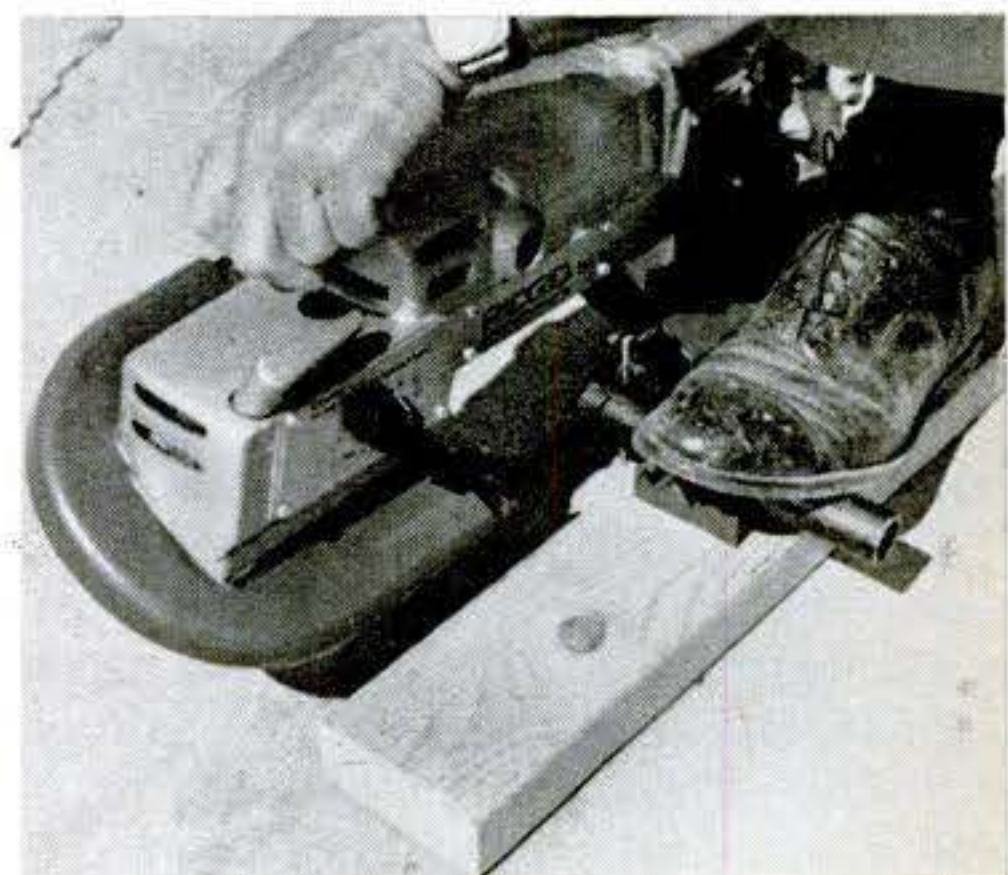
The Ridgid bandsaw is intended for commercial use, and everything about it tells you that it's got 40 hours a week built in for years to come. Base price of the single-speed 941 alone is \$260; \$269 for the two-speed; \$316 for the multi-speed.—*E. F. Lindsley*



Pipe or bar stock up to 3 $\frac{3}{8}$ " fits in gullet. Larger stuff? Turn in clamp to bring uncut side on top.



Cutting is smooth, even with saw held improperly (pipe should be against rear stop). Saw won't jump or fight.

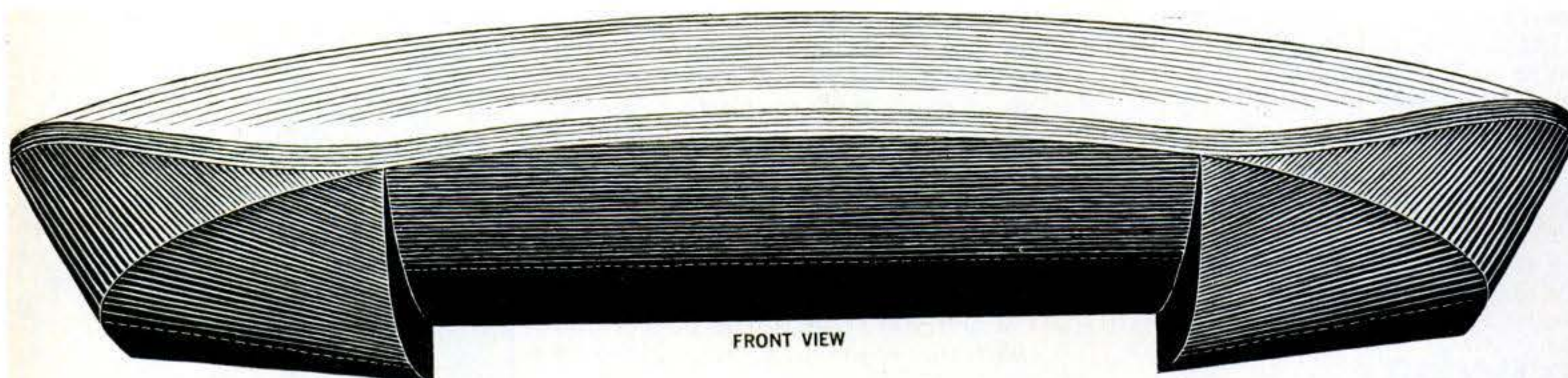


A piece of pipe, held down by author's toe, is cut easily. Saw works anywhere you can carry it.



Outboard Marine's Johnson-outboard-powered tunnel hull planes with only a few inches of the craft in water.

Those Hot Tunnel Hulls...



These offspring of ancient catamarans are stable, light, and smooth—even in rough water. But there's a catch

By JIM ROE / *PS Boating Editor*

Take one deep-V boat. Saw it down the middle. Fasten the two half-hulls together again with a flat deck mounted about halfway between the lowest part of the keel and the top of the hull.

That's not the way Italian designer Angelo Molinari, who developed tunnel hulls, did it, but it does describe the basic design of a tunnel-hull boat. First introduced in the United States about 10 years ago, the tunnel hulls have completely dominated the outboard racing circuit. Now a few boat builders are offering tunnel-hulled pleasure boats with performance similar to competition tunnel hulls. That's how the deep-V made its spectacular entry not so many years ago. Proving it on the race courses paved the way to recreational boat design.

The tunnel hull has rendered the deep-V obsolete in outboard racing. But is the tunnel really so good? Will it be accepted as a pleasure boat, or just as a racing machine? What are its pros and cons?

To find out what they're really like, I talked with racers, engineers, and builders. I've even driven some of the tunnel-hull racing boats myself.

First, the good news. The tunnel hulls are amazingly stable. They don't slip, trip, or pound, even at high speeds in moderately choppy water. When you start going fast in a deep-V, you're balancing the boat on a very narrow surface, about six inches wide. That's not very stable. Add another hull a few feet apart, how-



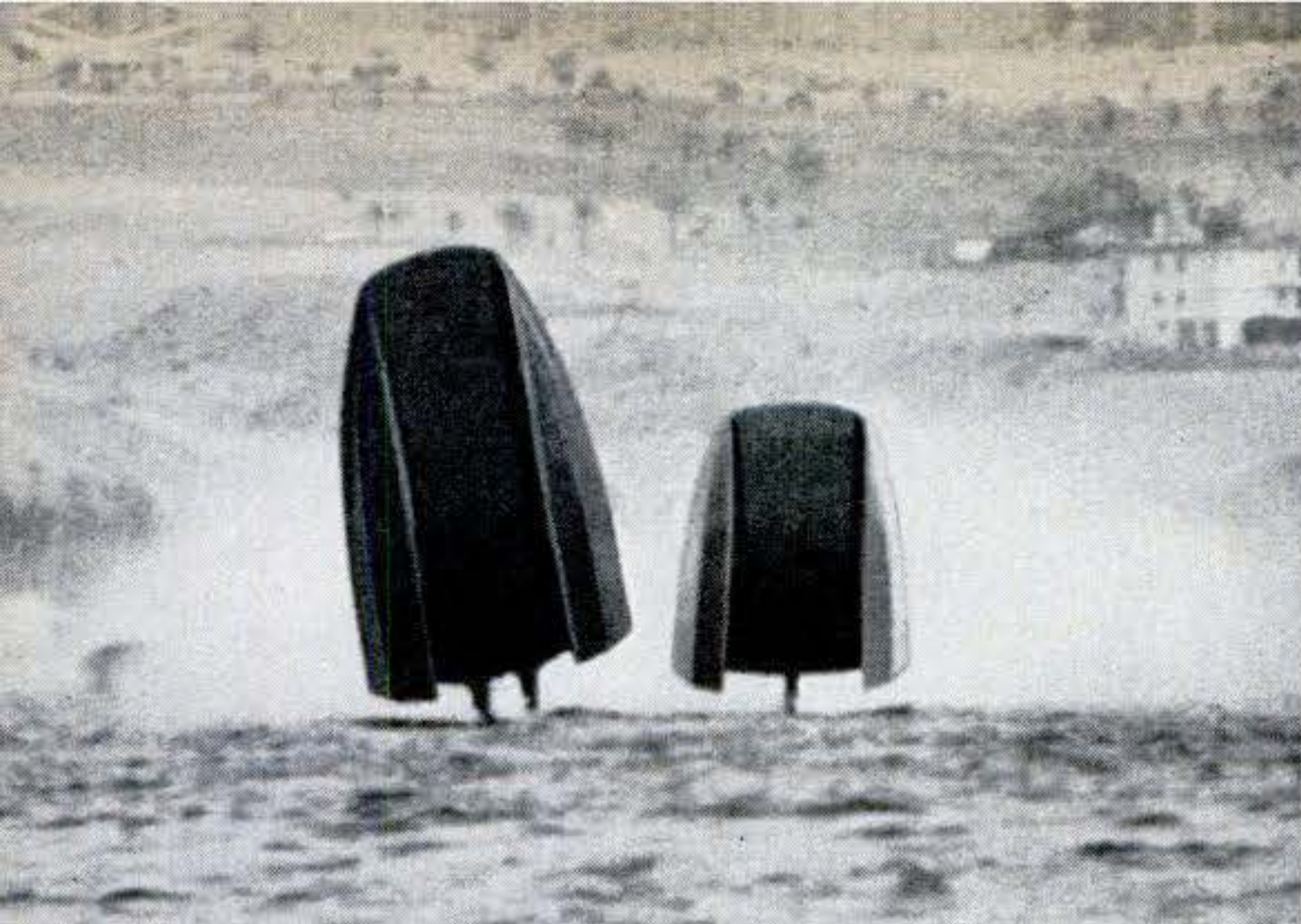
Tunnel-hull design has minimum of surface area in water, yet still has wide in-water beam. Since stability is function of the cube of the beam, there's less tendency to heel in sharp turns. The sponsons dig in rather than slide out.

ever, and you have a nice, wide platform beneath you.

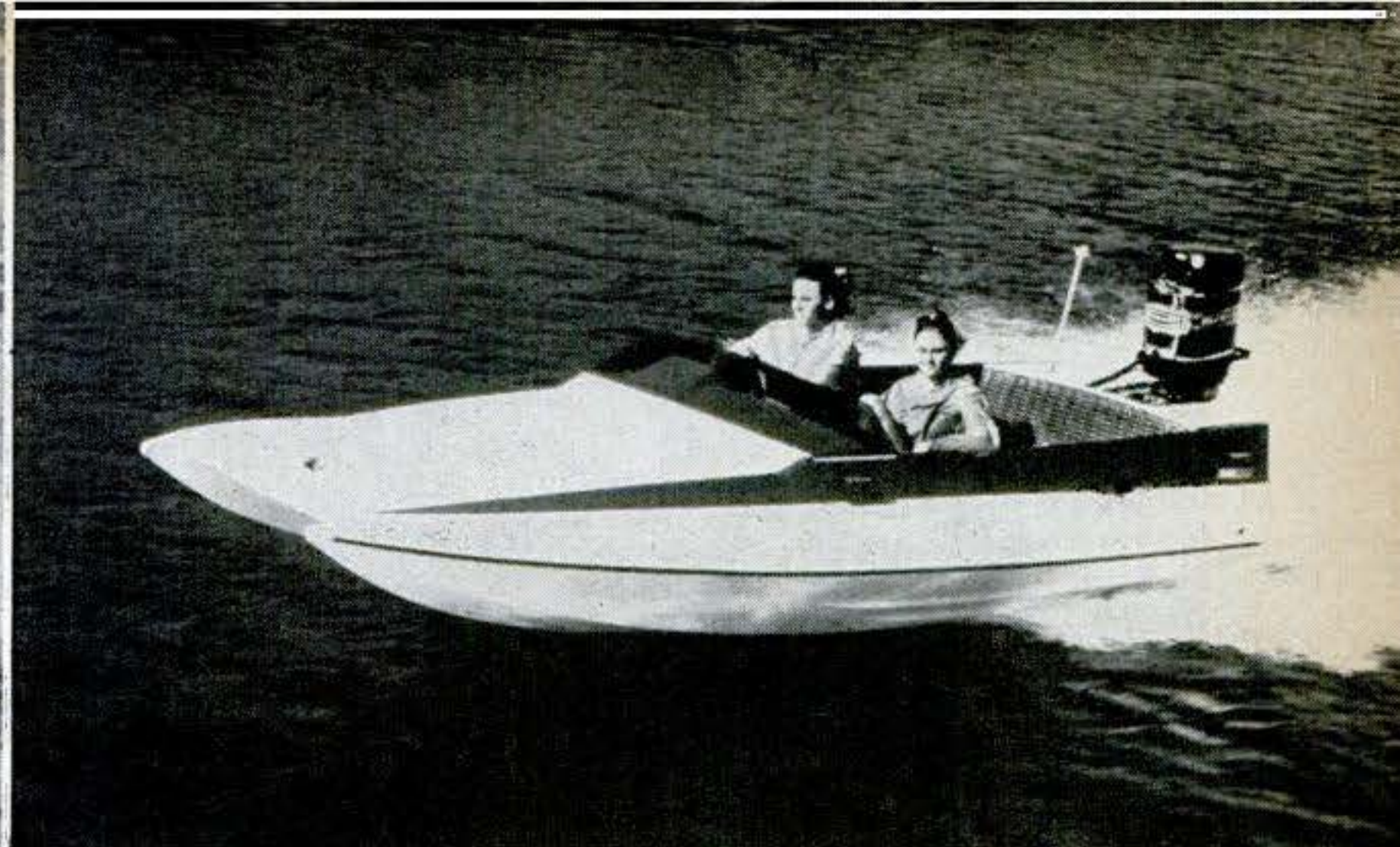
And, because the sponsons are fairly narrow (only nine to 12 inches wide on each hull), there's less hull surface area in the waves. At speed most of the tunnel hull's weight is actually airborne, supported by a cushion of air in the tunnel. That trapped air, says Dave Beach of the Outboard Boating Club of America, "exerts pressure on the bottom of the boat, which further reduces surface friction." You're riding more on smooth air than rough water. Result? A smooth and soft ride.

Tunnels handle well. The tunnel is also highly maneuverable. On sharp turns the V-bottoms tend to skip out and porpoise. Not so with the tunnel hull. "It's like riding in a Corvette," says Bill Evers of Ebko Industries, Inc. (a tunnel-hull maker). "It steers and doesn't slide to the side. When you go into a turn it feels like you're on railroad tracks."

There are some basic disadvantages. One of the biggest dangers connected with tunnel racing jobs is the tendency of the bow to become airborne at high speeds. Since you're riding mostly on air, there's a possibility of getting up too high. Lars Granholm, a naval architect who has worked with the OMC racing team, cautions: "They're longitudinally unstable. You have to feel the boat. Too much airlift and you go over."



Two racing boats "kiting" at high speed reveal potential danger of tunnels. It's caused by air-pressure buildup.



Road Marine's 17-foot outboard Marathon sells for \$2295. Also available are several stern-drive tunnel hulls.

They're Making Them For You Now

Another limitation has to do with comfort. The cockpit arrangement needs a new approach in styling. You're sitting on top of a tunnel, pretty high up, with very little leg room. (Racers sit with their feet stretched out, hardly comfortable for recreational boating.)

There are some things a tunnel boat won't do as well as other designs. Road Marine Corp.'s President, Jim Hawley, reports that their ability to carry weight is considerably diminished. He says, "When you're depending on the boat to lift free of the water with a given amount of thrust, there's a certain point where the weight overcomes the ability of that thrust to move it ahead fast enough to gain aerodynamic support. If you want to haul heavy loads, forget the tunnel hull."

Who makes 'em? In California—spawning ground for high-performance boats—Holmes Fiberglass Co. in Costa Mesa builds tunnel hulls powered with outboards, stern drives, and jets. One model, a 22-footer, weighs about 950 pounds. Another, a 20-footer, has room for six. With outdrive, it costs around \$4600.

Holmes also has a trailerable 23-foot cabin cruiser with a jet drive. On one craft they installed a 454-cubic-inch engine with a jet drive in each hull. The engines deliver 405 hp to produce a 75-mph top speed. The 23-foot cruiser is a plush model with bunk beds. Says Bill Holmes, "It has two air tanks in each hull, and I don't think it's possible to sink it."

Road Marine in Scottsbluff, Neb., has designed and built a 17-foot outboard and a 21-foot stern-drive, and has been developing a 24½-foot cruiser powered with twin engines.

The 17-foot Marathon went for \$2295 and is designed primarily for the water skier. The 21-foot Grandee, a big, luxurious runabout, is built to handle up to seven passengers. Maximum BIA horsepower rating is 245. It's powered with the 188-hp MerCruiser stern drive (at \$7245), the 185-hp American Challenger stern drive, or the 245-hp OMC stern drive.

But RM's tunnel hulls are currently awash in deep financial waters and, as we go to press, it is uncertain if Road Marine will continue to build boats.

In Juniata, Neb., Ebko Industries has been building tunnel hulls for quite a while. The 14-foot Sprint is a sport boat. Next largest is the 15-foot Ski Bee with angle feet and a very deep tunnel—about 8½ inches. The Ski Bee, at 250 pounds, is the fastest of the Ebko boats.

Ebko also builds a 16-footer, but the boat that attracts the most attention is their tunnel-hulled bass

boat. It's just under 15-feet, weighs about 600 pounds, and is rated for 80 horsepower.

What about safety? Are tunnel hulls really safe for you and me? What about accidents? Gary Garbrecht, director of racing for Mercury Marine, says, "One reason for the mishaps with the tunnel hull is that there aren't many around yet. Not enough people have had experience handling them."

You can prevent accidents with common sense. If you're in a V-bottom boat crossing a large wake, you know you've got a problem. You have to slow down and be careful. It's no different with a tunnel hull.

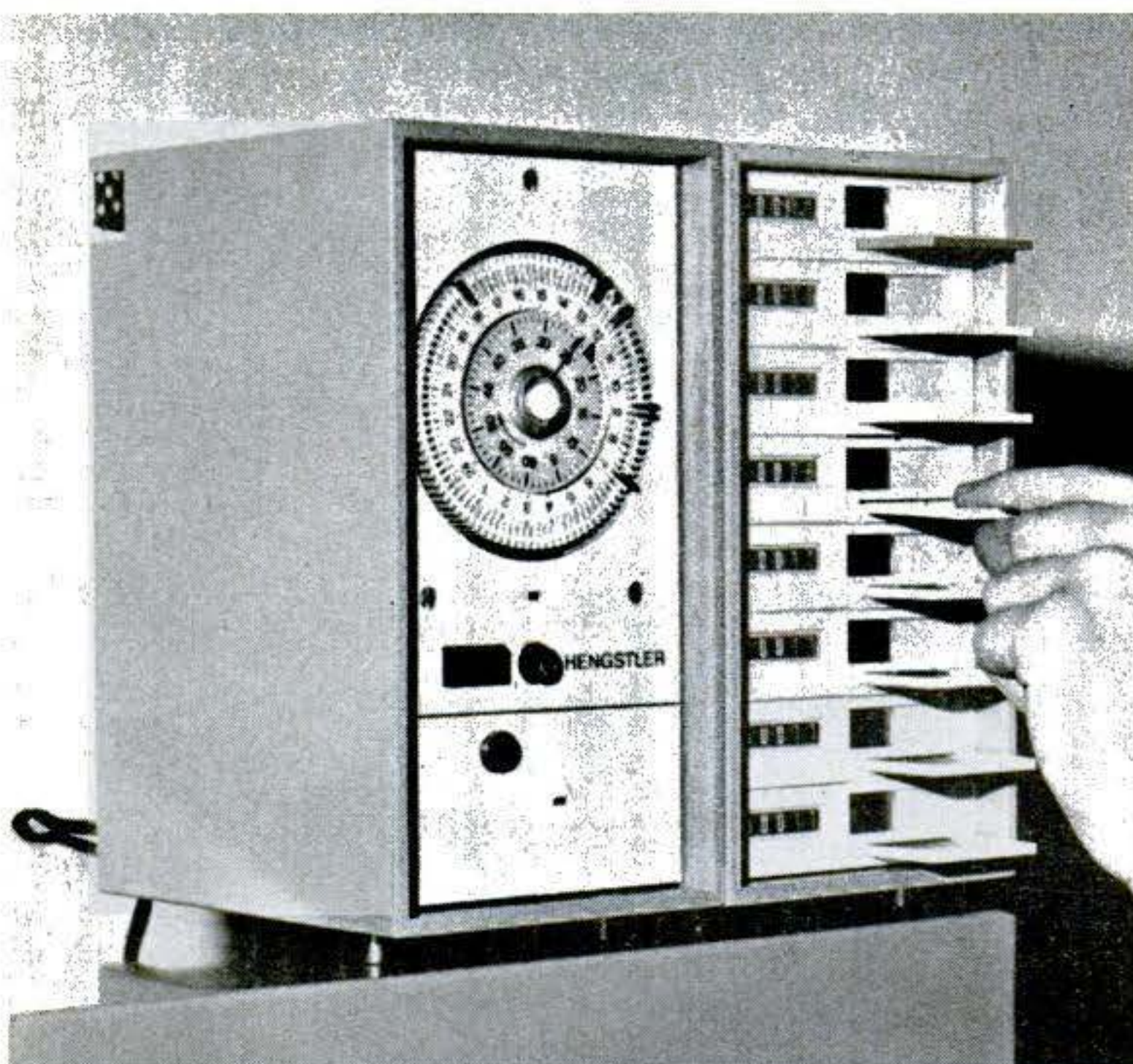
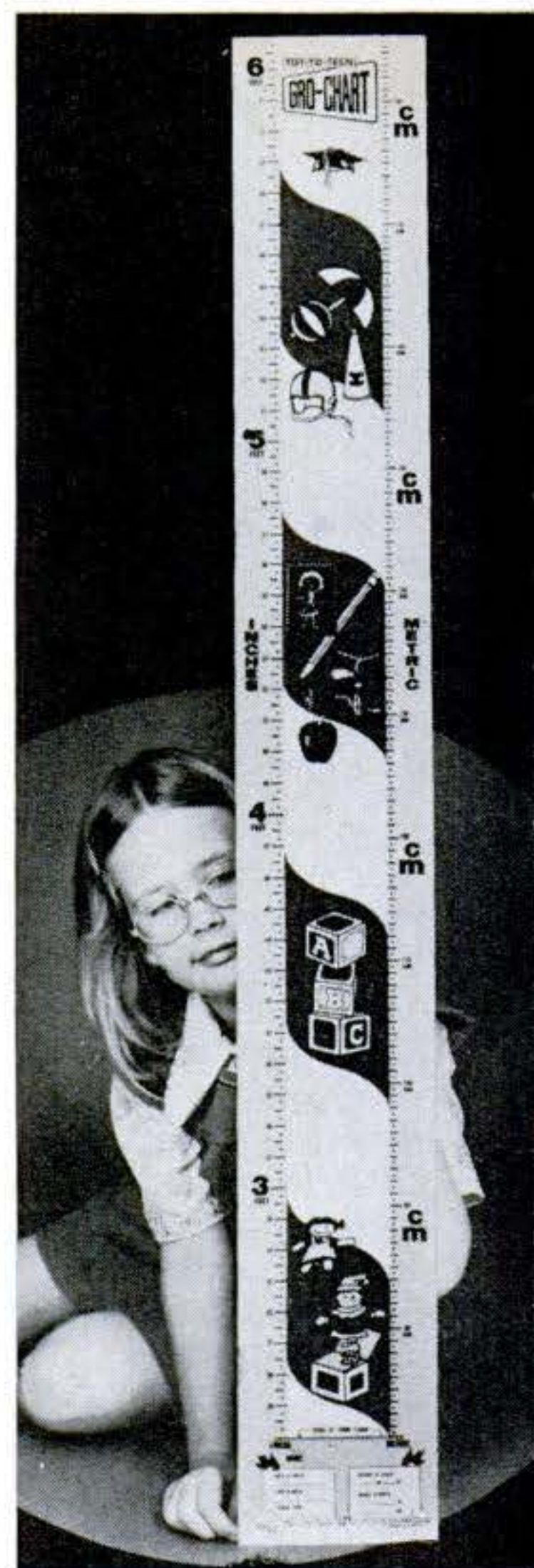
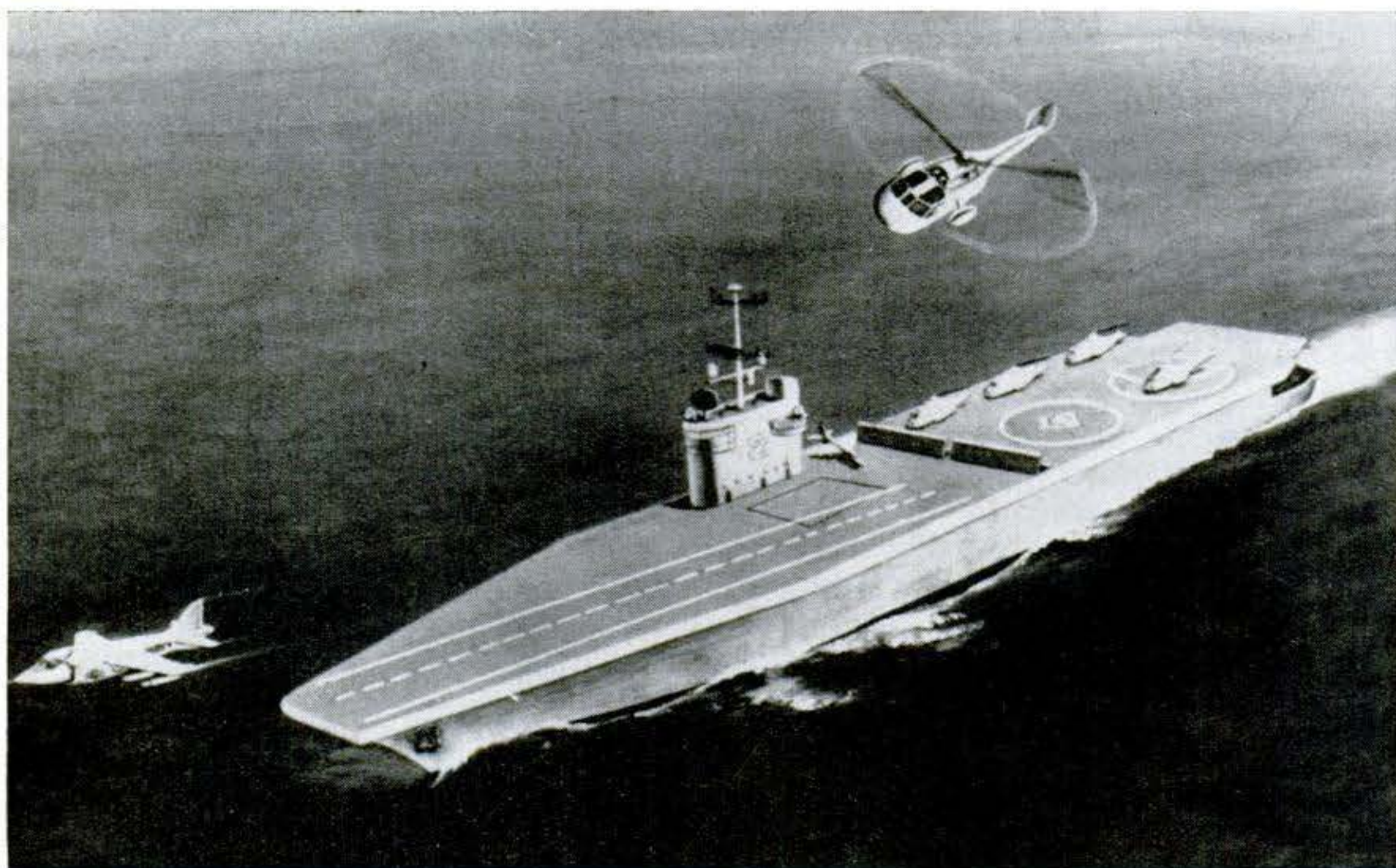
It's worth test-driving a tunnel. I'm sure you'll be impressed with its sports-car handling and luxury-car smoothness. "So far, most people have seen them only in races. They're a little scared of them as family boats," says Bill Holmes. "But I think they're the hull of the future." PS



Twenty-two-foot tunnel from Holmes Fiberglass Co. has stern drive, weighs only 950 pounds. There's a jet model, too.

What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS



Control ship

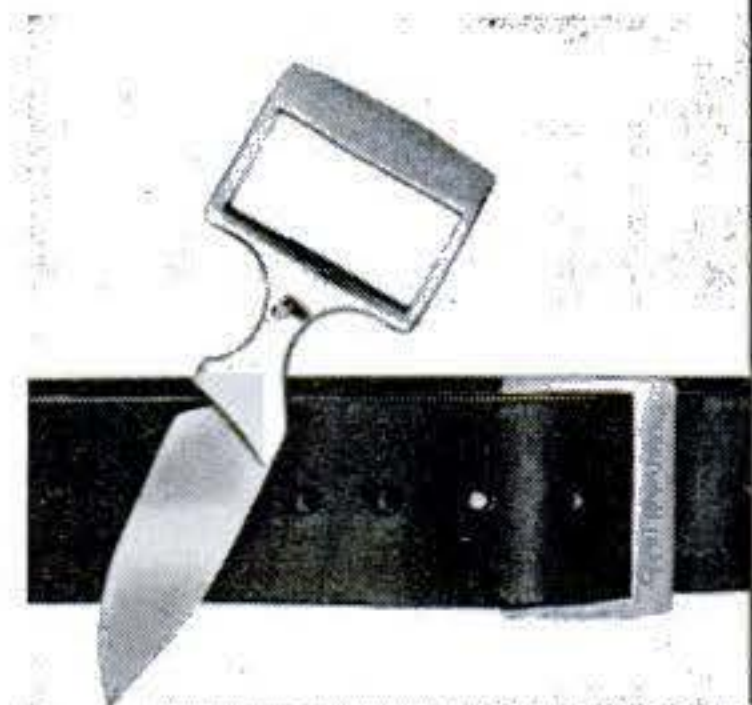
Mini-aircraft carrier? It's a Navy idea for a Sea Control Ship. Some 17 helicopters and V/STOL aircraft—its sensors and weapons—would help provide sub, ship, and air defense for convoy and other vessels. Design figures: 14,100-ton displacement, 630-ft. length, and speed over 24 knots.

Self-timer

Employees can select their own starting and quitting times with the Flextime system. A personal coded activator key starts and stops an accumulator that tells how many hours you've worked that week. The system is being introduced in the U.S. by Flextime Corp., 60 E. 42 St., New York 10017.

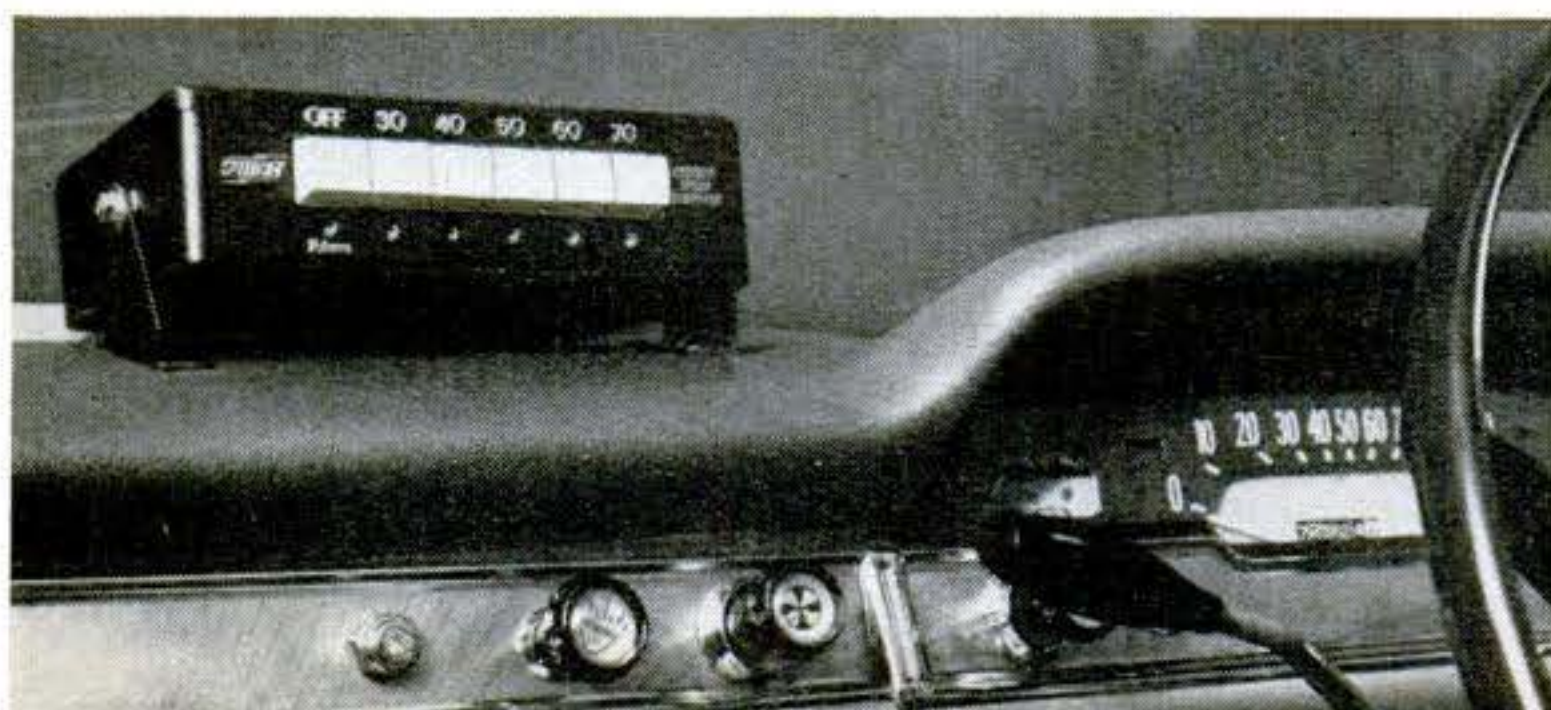
Growth chart

Keep track of your child's growth—in inches and meters—with this premarked chart. You hang the four-ft. Tot-To-Teen Gro-Chart 28 in. from the floor. Adhesive-backed arrows for 15 birthdays, plus a marking pen, are included. Safco Mfg., 6500 Depot Dr., Box 7898, Waco, Tex. 76710. Price: \$4.98.



Belt knife

You can't forget to carry this little knife—it's also a belt buckle, and slips into a sheath in its cowhide belt. The sportsman's knife, of specially hardened stainless steel, works as a cap lifter, too. Bowen Knife Co., 593 Westminster Dr., N.E., Atlanta, Ga. 30324. \$30 with belt.



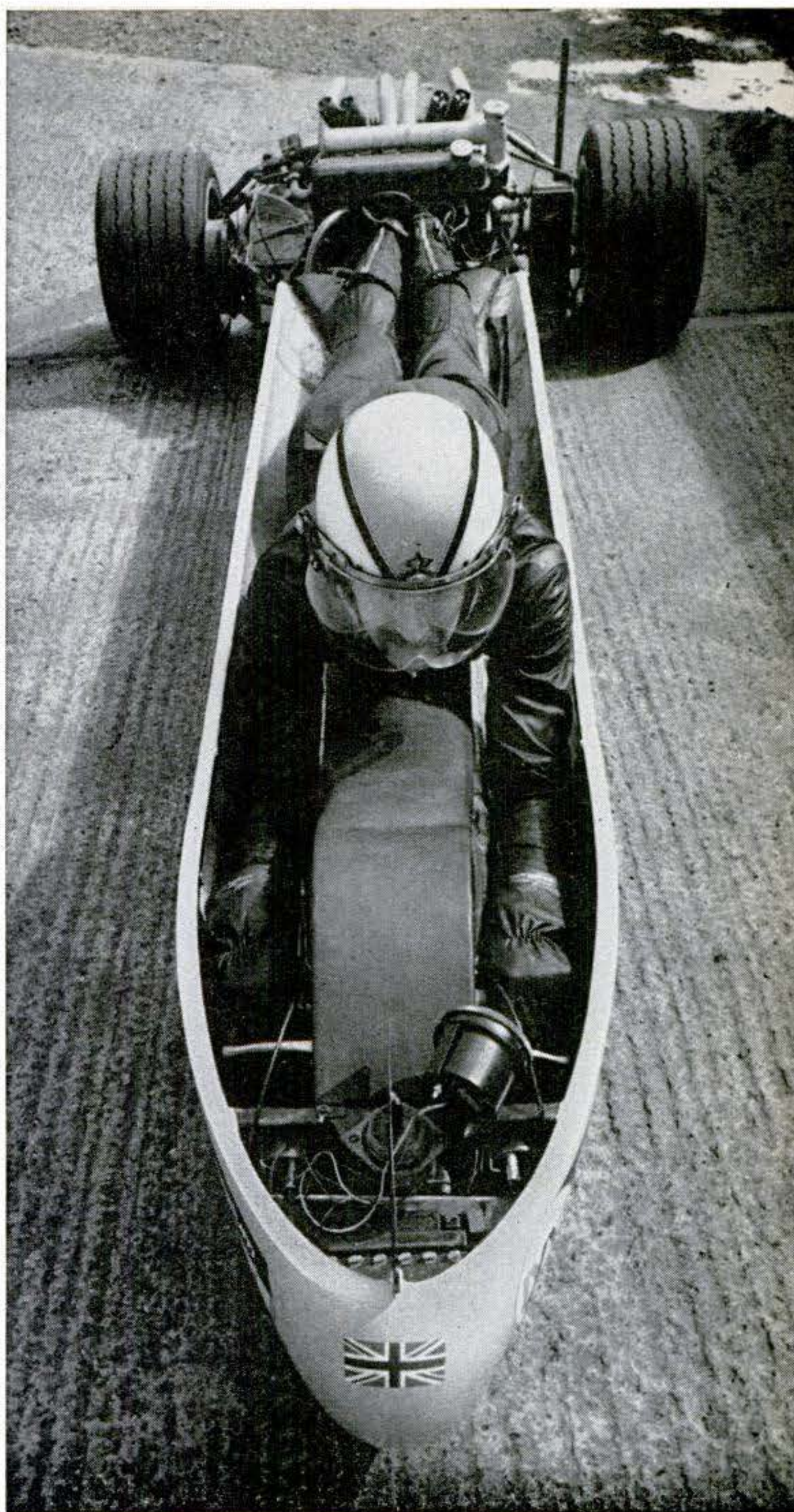
Speed computer

Five buttons on the Speedset let you quickly set your speed limit—from 30 to 70 mph—to suit driving conditions. A buzzer sounds if you exceed the speed setting. The solid-state warning computer can be fitted quickly to any car. Autaments Ltd. of New St., Oadby, Leicester, England.



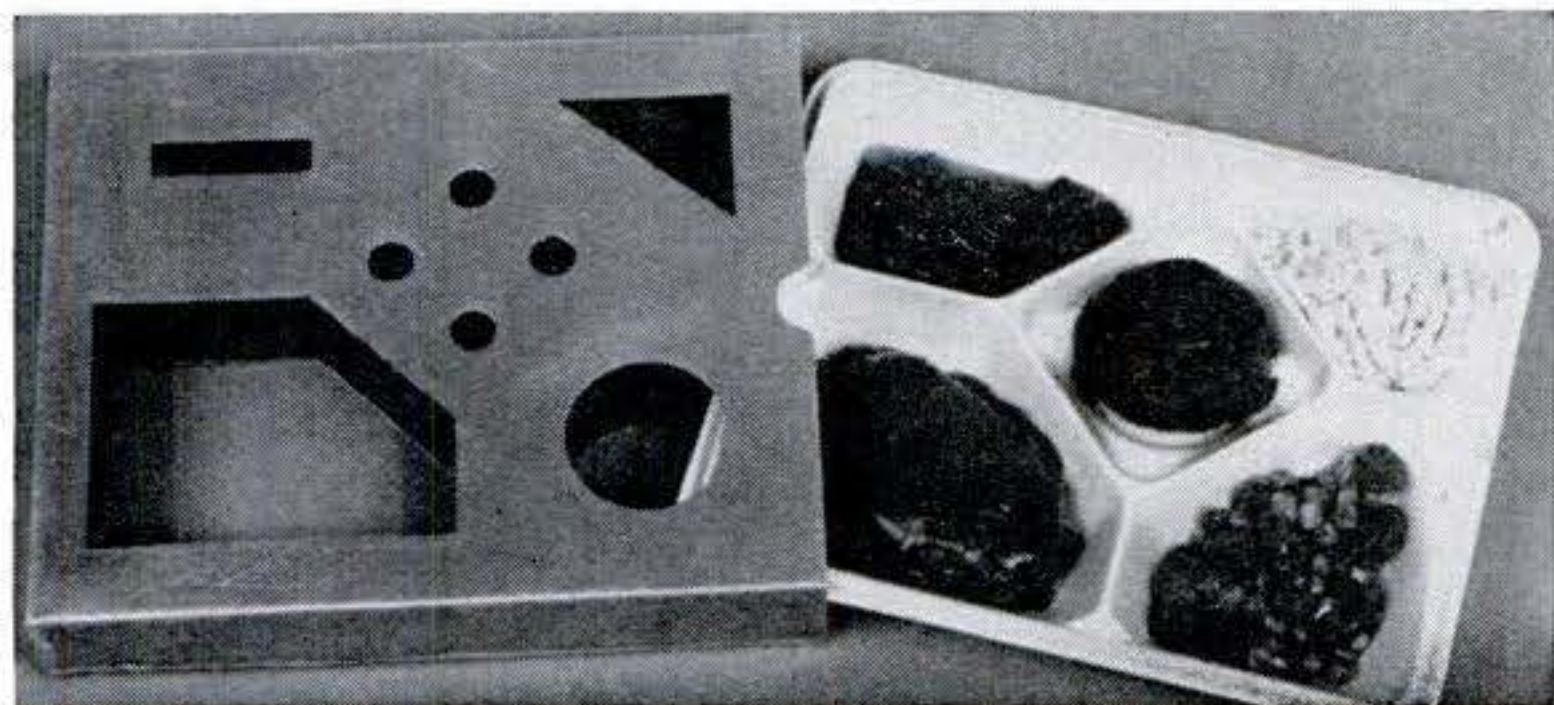
Videophone: pushbutton hands-free calls

A bright, high-resolution 5-by-5½-inch picture is delivered by this German videophone. For easy viewing, the desktop unit swivels on its base, and the camera tube tilts up or down six degrees. Pushbuttons on the telephone unit control the picture, and automatic aperture controls insure clarity. Volume can be varied. Using the internationally proposed standard video bandwidth of one MHz, the device, made by Siemens, can be used, in addition to hands-free phone conversations, to transmit rail and air timetables, news reports, merchandise information, and bank identity checks.



A quarter mile in 11.2 seconds—on his belly

World's fastest cycle car can rocket up to 200 mph, and has done a standing-start quarter-mile in 11.2 seconds with a terminal speed of 123 mph. The supercharged Ford 1300cc engine is mounted transversely in the tail over the fat Grand Prix tires. There's no gearbox, only a torque converter. The reclining rider operates all controls with his hands. Handlebars are linked to the single front wheel, which swivels for steering and rolls on a sphere centered in the hub. The British dragster is 10 feet long.

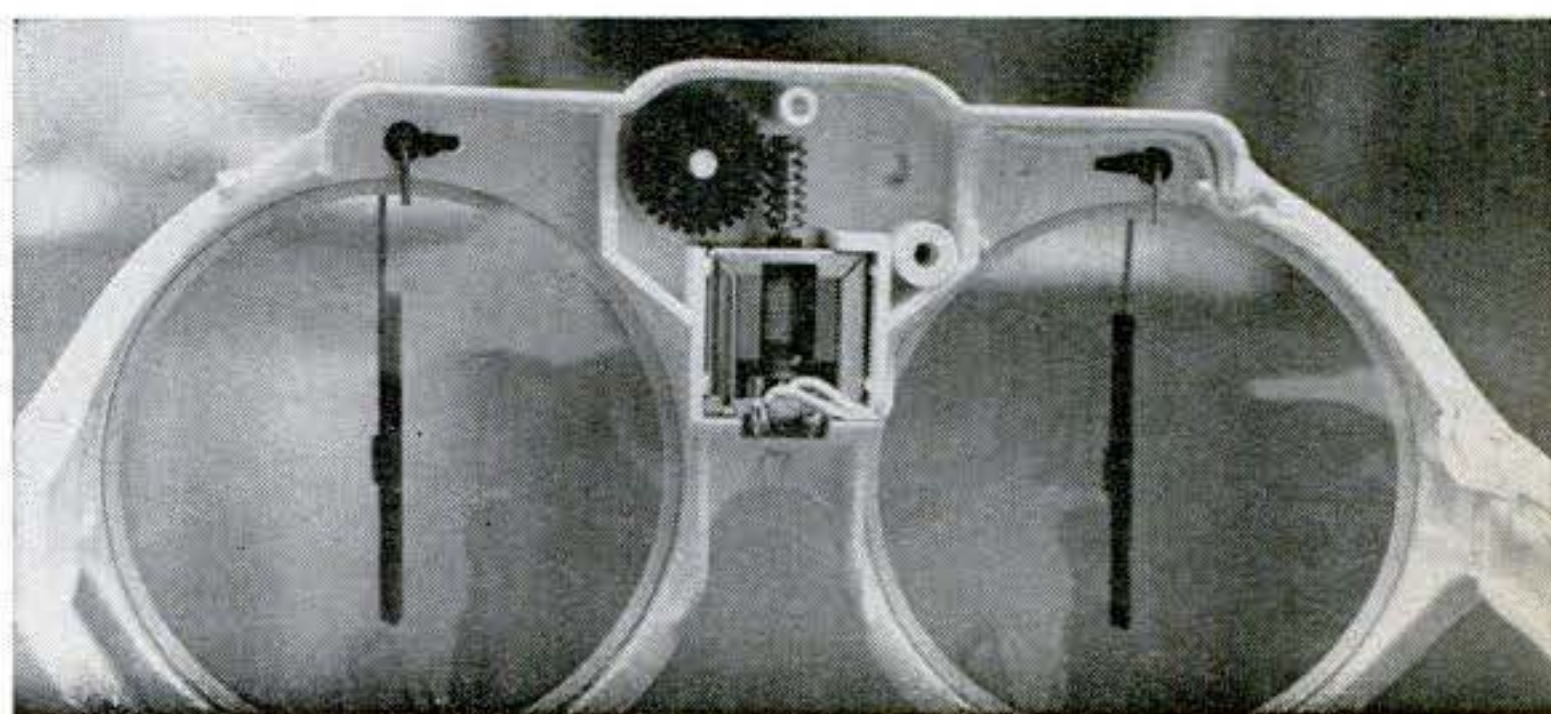


Microwave mask

Slip frozen meals into this container and they'll cook perfectly in a microwave oven. Openings determine how much energy each food absorbs. Teckton, Inc., Waltham, Mass., makes them for institutional use. Throwaway paper/foil versions for TV dinners may be made when more microwave ovens are in homes.

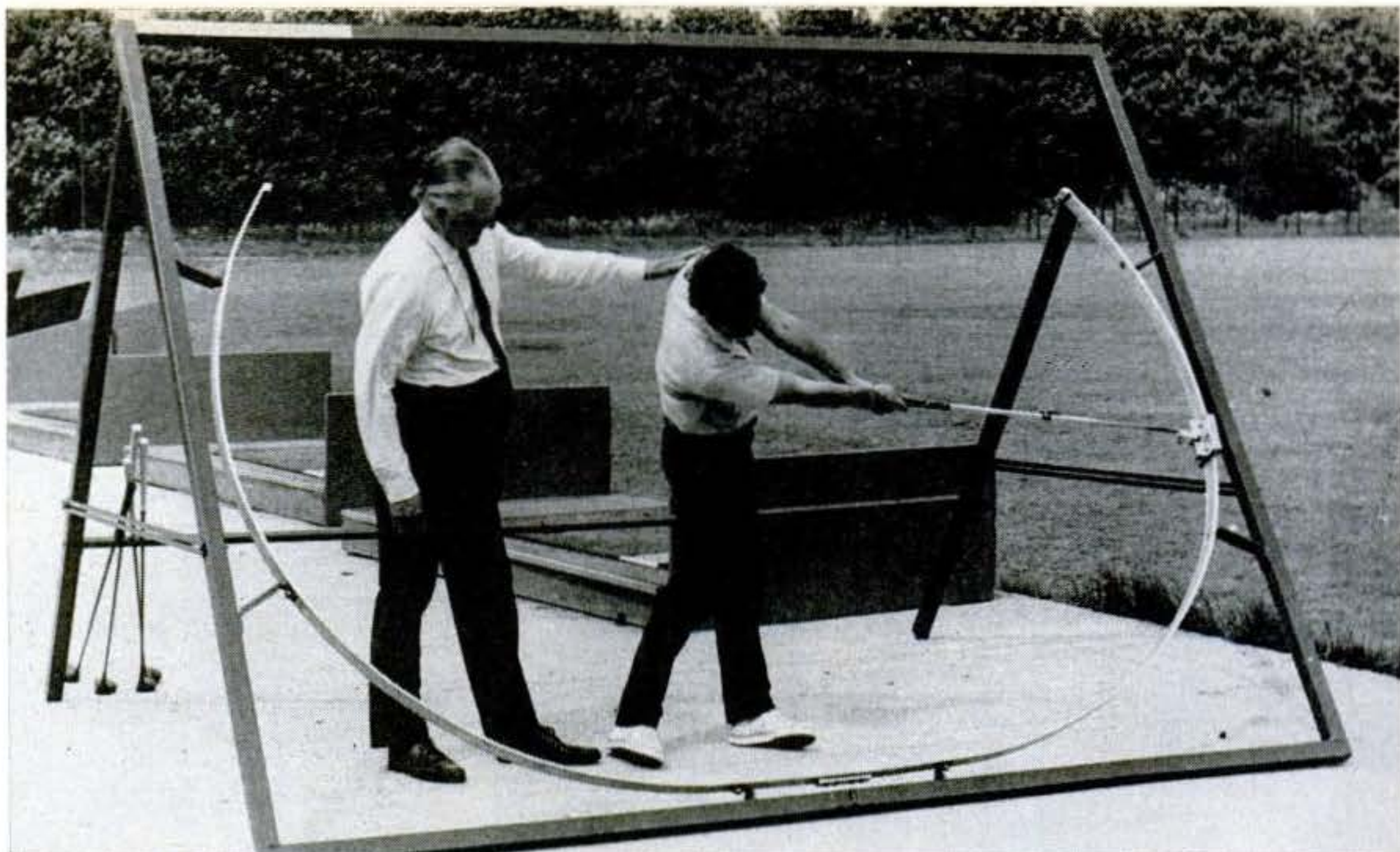
Spectacle wipers

Press a button on the eyeglasses at right and tiny wiper blades go into action. The battery-operated glasses weigh 2½ ounces, and can be fitted with prescription lenses. Etablissements Tagada, 65-75 Rue Armand Lepine, 92 - Bois Colombes, France.



Rail rider

Check your golf swing? You know when you're in the groove with this English Swing Builder. The club head fits in a trolley that rides the rail. Only a perfect swing produces a smooth drive without pull. Islington Metal and Plating Works, Torrens St., London E.C. 1., England.



Dickied-up Olds

If the Oldsmobiles that GM makes don't suit you, try the Hurst/Olds. Based on the Olds Cutlass S coupe, it offers gold body accents, landau-style vinyl half-top, hood scoops, and decorative rear quarter windows. Upholstery is "wet-look" vinyl, and bucket seats swivel. Olds dealers handle 'em.



Bag belt

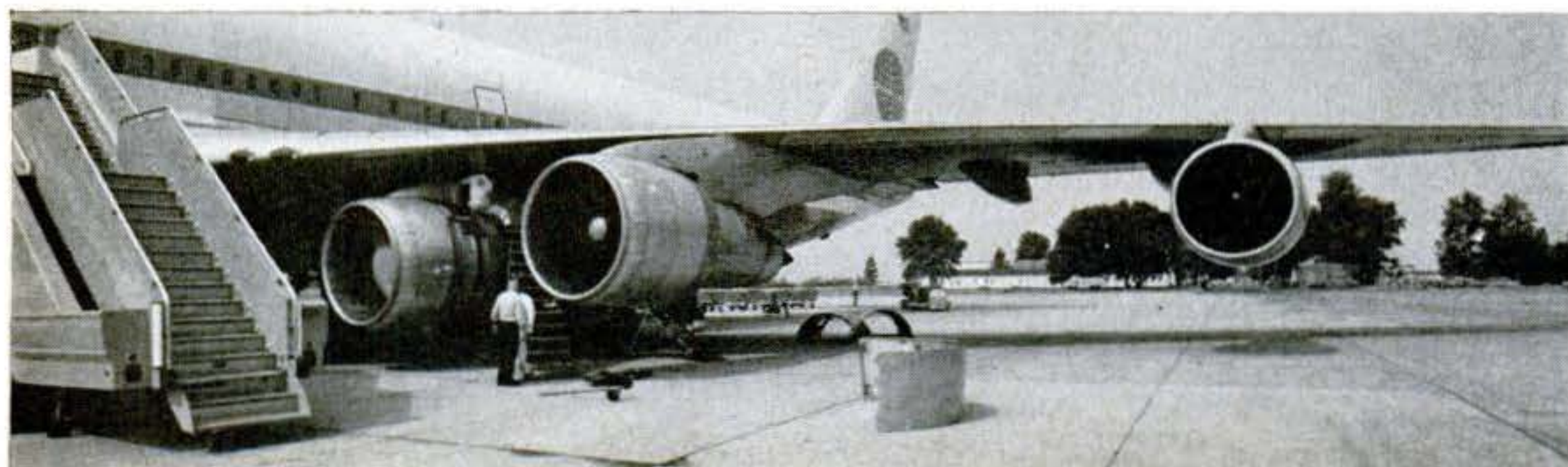
The best of both possible restraint systems—seat belt and air bag. So says Allied Chemical Corp. of Morristown, N.J. of its new inflatable belt. On sudden deceleration signaling a crash, the belt expands to a pillow-like six-inch diameter. Unlike the bag, it stays inflated until the belt is released.

Recycler

What do you do with a trike when the kids outgrow it? Turn it into a bike. With a hacksaw (to slice into the frame) and a Trike-to-Bike kit, you can recycle that tri-cycle into a bicycle. The kit is \$3.95 ppd from Aloha Mfg. Co., 5005 Kalaniana'ole Hwy., Honolulu, Hawaii 96821.

Head light

Attach a blinking red light to a leather strap with elastic ends. Add metal hooks that'll grip a helmet. Add two six-volt batteries for about 14 hours' power. Result: a safety device for policemen, cyclists, and hunters. In Calgary, Alberta, Mart Industries sells the Safety Light Strap for \$5.



Extra-engine plane

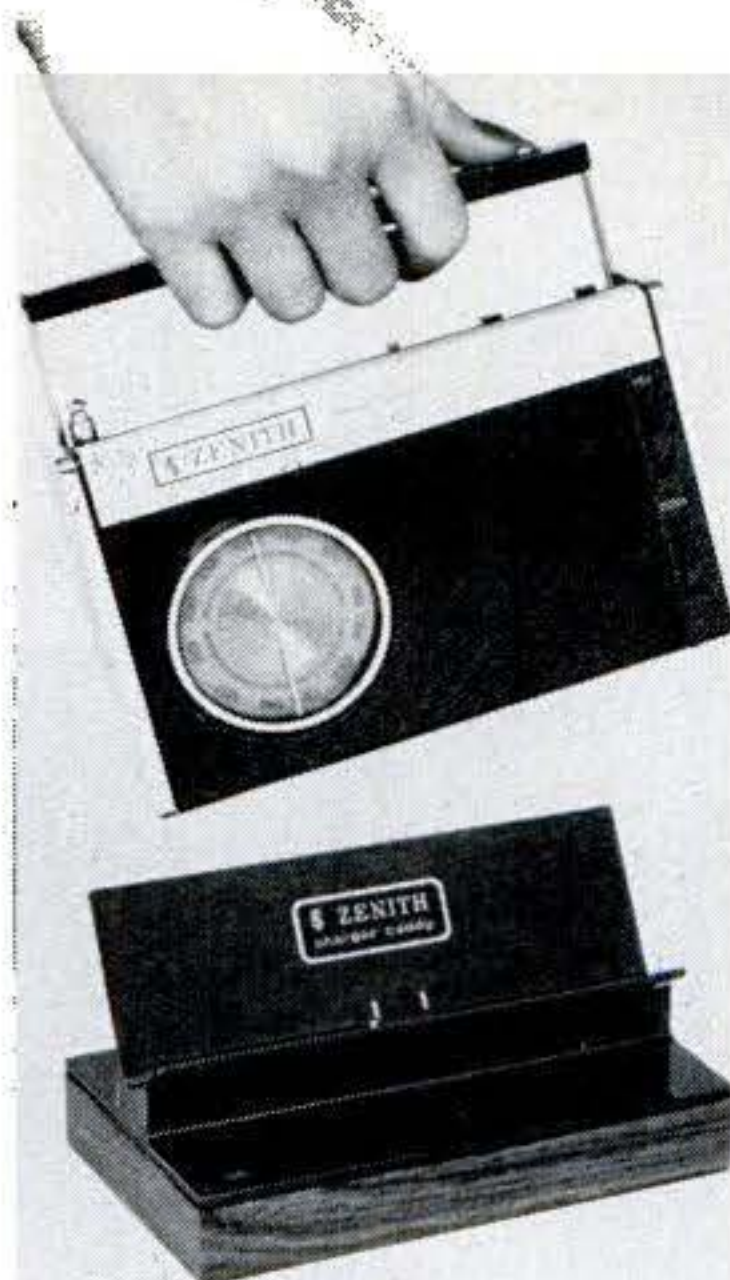
How would you carry a spare 747 jet engine for a plane stuck in Vienna with engine problems? Pan Am hangs it on an inboard wing mount of a scheduled plane. A special nose cone streamlines it in flight and keeps it from wind-milling. The \$850,000 engines aren't stockpiled all over.

What's New IN ELECTRONICS



No-gear turntable

There's only one moving part in this turntable—the turntable itself. The direct-drive table is actually an extension of the motor shaft—which makes it part of the motor. The result: exact rated record speed and virtually no rumble. The Technics SL-1200 turntable by Matsushita, it's \$269.95.



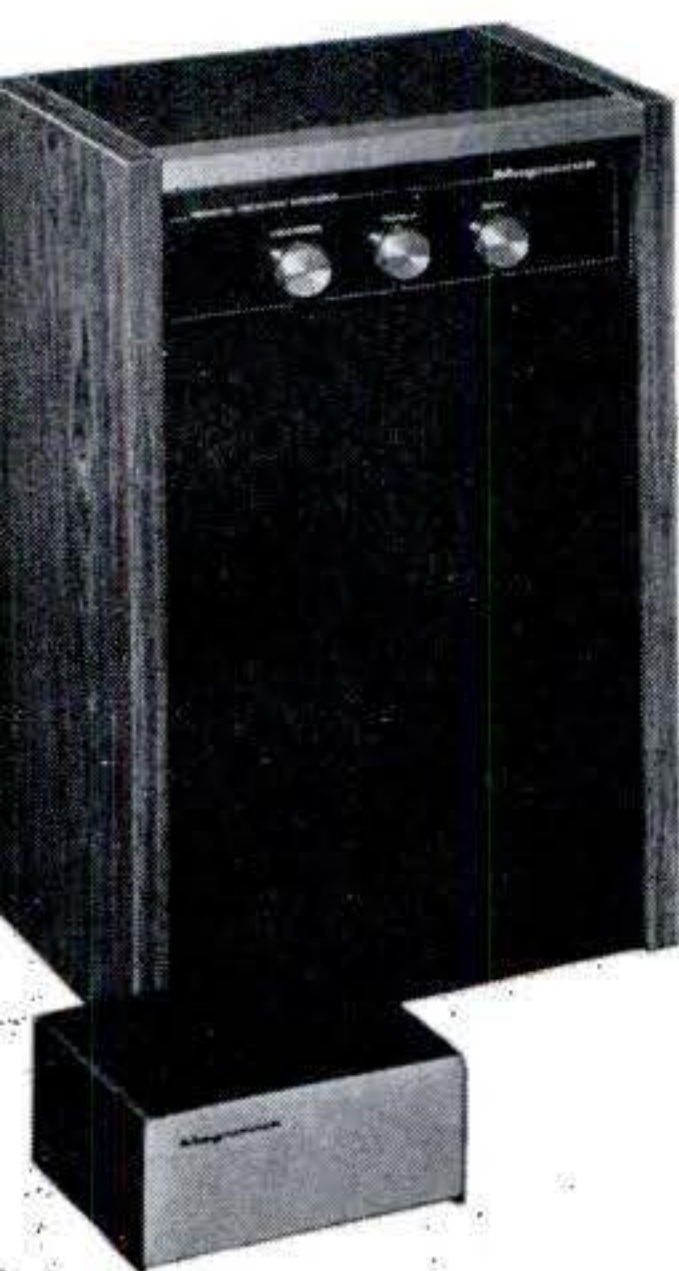
Recharging AM/FM

Place this new AM/FM portable from Zenith in its recharging stand for the night and it's ready to go when you are the next day. Three AA nickel-cadmium batteries power the radio. A pilot light indicates all is well when charging. The 10-transistor Royal E27Y is \$39.95.



Wraparound

You don't drape these earphones over your head—you lie on them. Speakers are mounted in acoustic baffles molded into interior foam. Hear Muffs come in two- and four-channel versions from \$29.95 to \$99.95. Hear Muffs, Inc., 513 Rogers St., Downers Grove, Ill. 60515



Wireless speakers

No wires for your stereo speakers? Right. This Sound Land speaker system from Magnavox uses a wireless transmitter to broadcast music over your house wiring. Want stereo in the den? Just plug in the speakers at any convenient AC outlet. \$169.90 buys the setup.



3-in-1 recorder

Akai's new recorder does it all. The front deck records and plays back reel-to-reel tapes, lower front recording heads take on cassettes, and a side deck accepts eight-track cartridges. The unit will transfer sound from one to the other. The Akai S-2000SD is \$549.95.



Variable speech

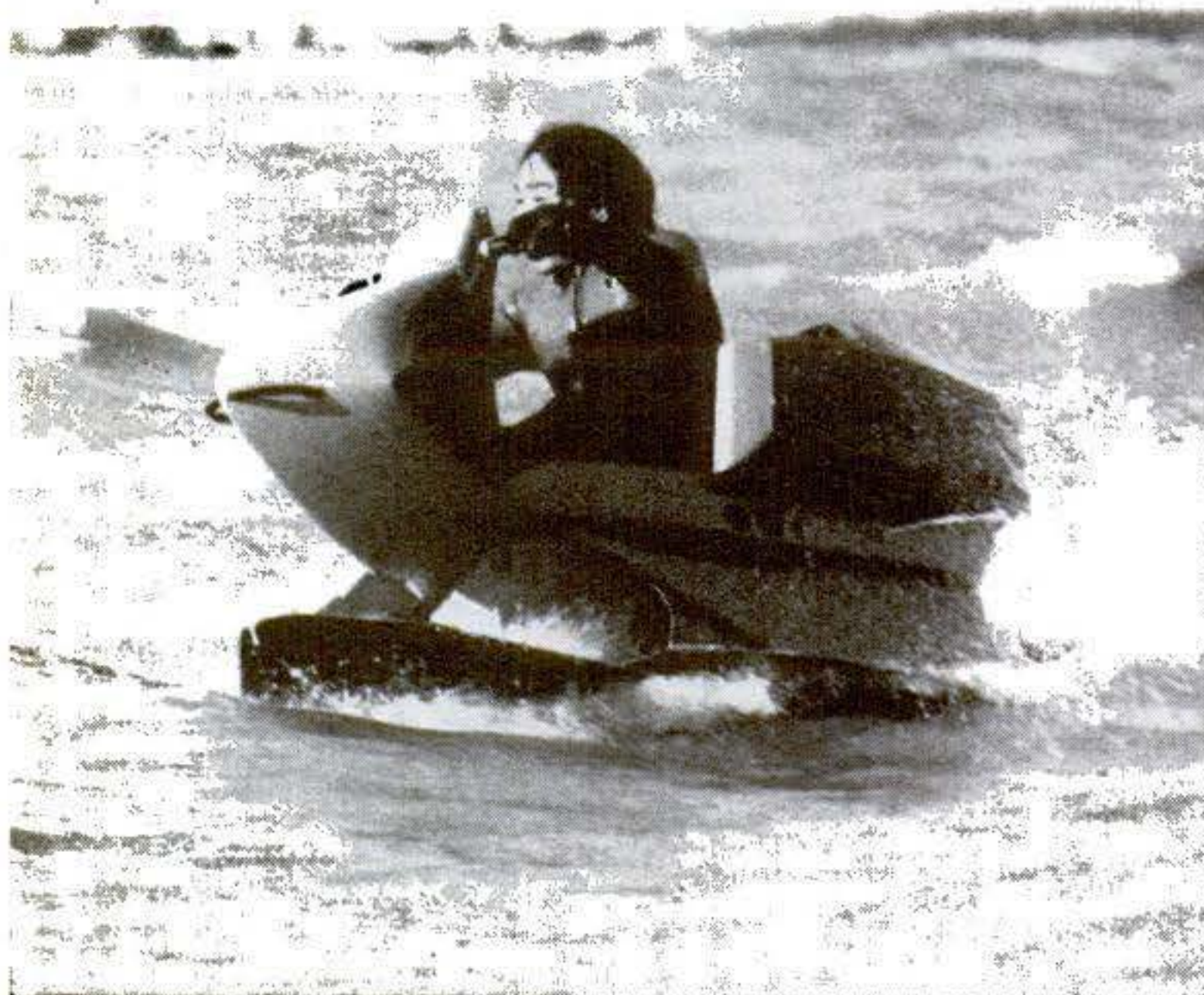
Good-bye to that Donald Duck effect! Magnetic Video's portable cassette recorder contains a variable speech control (VSC) that enables you to speed playback by 2½ times without any change in pitch. Price: \$500. Magnetic Video, 23434 Industrial Park Ct., Farmington, Mich. 48024



What's New IN BOATING

Sea sprite

Power-Ski's the name of this 195-pound, 20-hp, 30-mph craft. Called a "motorcycle for the water" by the maker, it planes along on fins and front ski. A 3½-gallon tank provides two hours' fuel and a 50-mile range. Cost: \$1395. Power-Ski Corp., 5500 N. Northwest Hwy., Chicago, Ill. 60630.



Trolling motor

Are you an angler who needs both hands for fishing? The Mark V electric trolling motor has a three-speed foot throttle. The 25-pound-thrust unit works on 12- or 24-volt batteries. A circuit breaker stops the motor if the prop hits an object. Gladding Corp., Box 260, Syracuse, N.Y. 13201.



Bilge cleaner

Forget scrapers and brushes, say the makers of Automatic Bilge Cleaner, a concentrate that mixes with bilge water to get out grease, oil, and gas. Eight ounces works on a boat up to 25 feet. Just let the boat rock and pump her out. The bio-degradable stuff sells for \$1.59 a pint. Sudbury Lab., Inc., Sudbury, Mass.



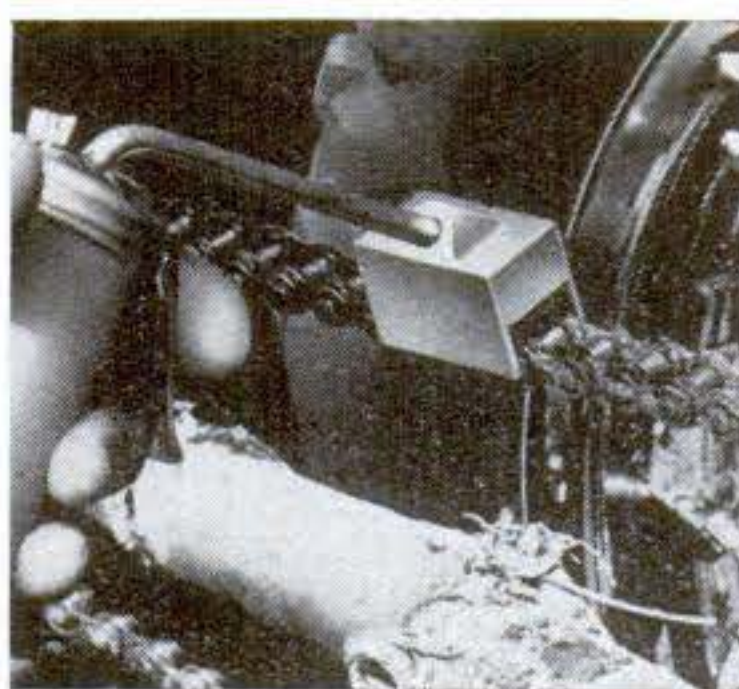
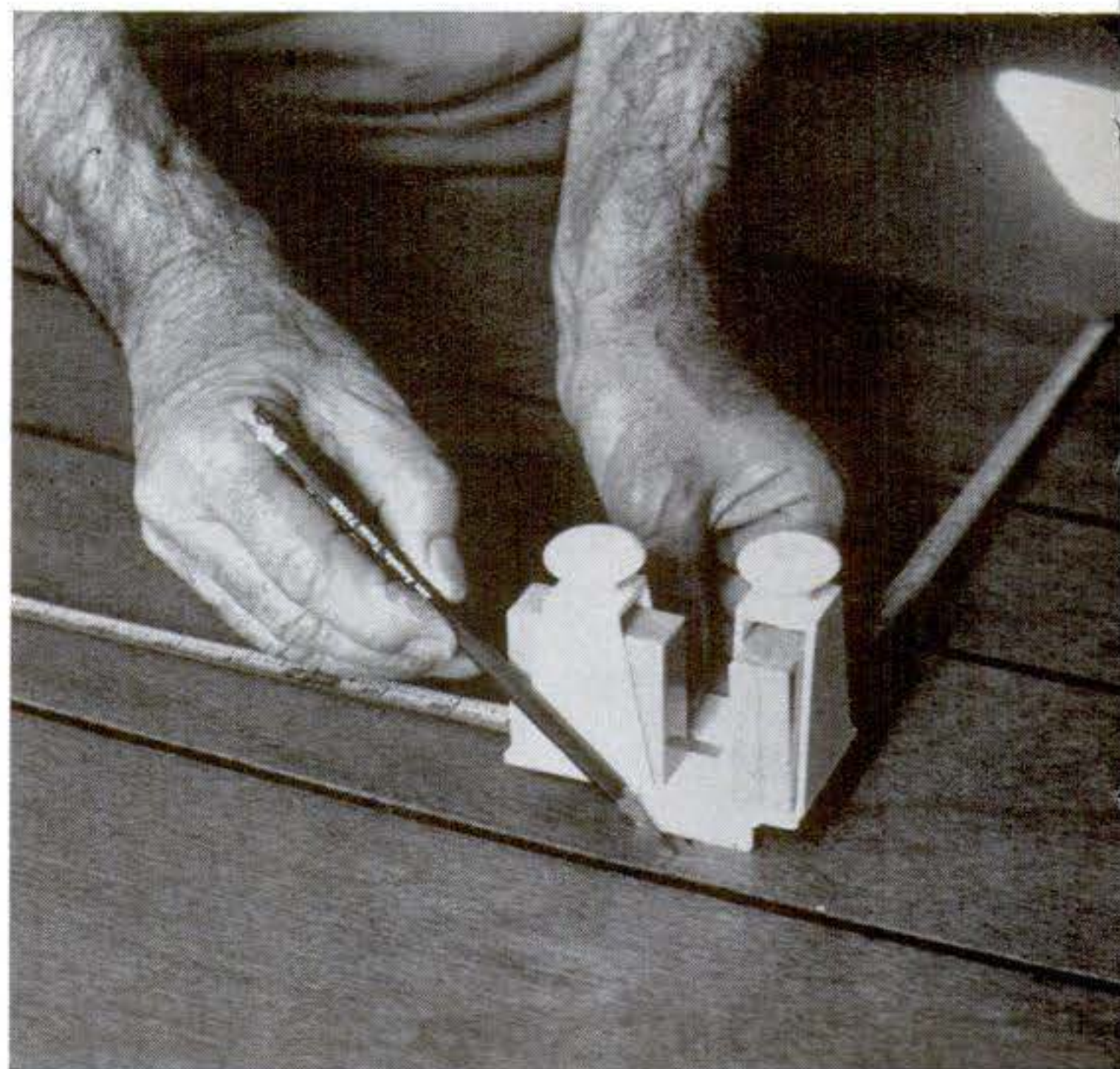
Troll-speed indicator

Want maximum effectiveness from your trolled lures? The Grizzly trolling-speed indicator may be for you. A water-weight keeps a wire leader vertical. As the boat moves, the weight creates drag and moves an indicator needle on a speed-coded scale. \$9.95. Maxwell Mfg. Co., Box 649, Vancouver, Wash. 98660.

What's New IN TOOLS

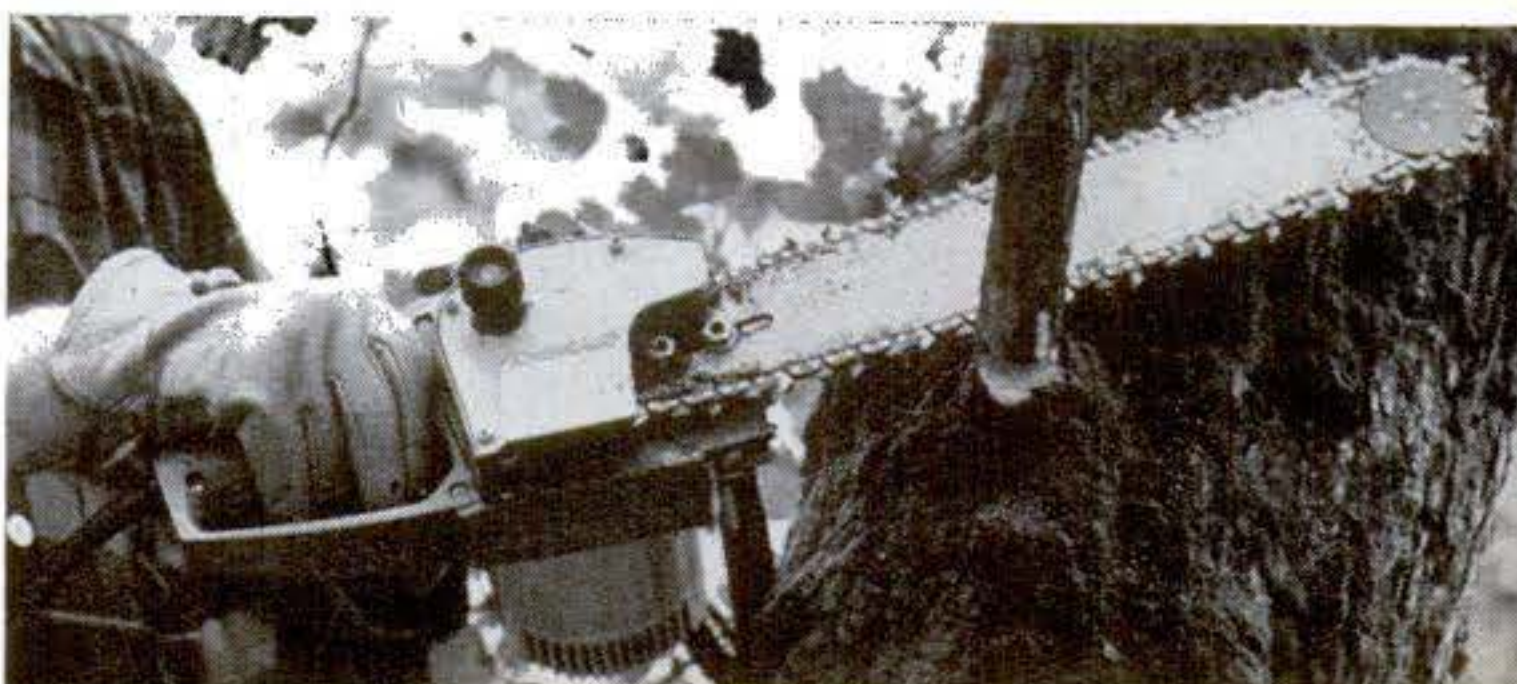
Outlet locator

Locating cutouts in paneling for electrical outlets is no trick with Panel Pal. It combines two tape measures and a template in a single tool. One tape measures the distance from the outlet to the floor; the other checks distance from outlet to edge of panel. Toolco, Inc., San Angelo, Tex., makes it. \$9.95.



Chain oiler

Lube your motorcycle chain right and it will last longer. Here's a tool to do the lubing. It attaches to the spout of your oil can and dispenses oil onto the chain through a special pad that removes dirt at the same time. Called Chain Mate, it's sold at bike shops.





EMF meter

Constant, precise readings on the power level in your battery—that's what you get from Charge Chek. It indicates voltage over a wide range, tipping you off to problems in voltage regulator, fan belt, generator, or alternator. In models from 6-42V. NHK Sales-America, 1200 6th Ave., Seattle, Wash. 98101.



Orbital workhorse

A sanding rate of 12,000 orbits per minute means the new Rockwell 96 sands fast and virtually swirl-free. A new all-ball-bearing motor means long life. Double insulation means safe operation, no bothersome three-prong adapters. The unit sands flush on three sides, costs \$29.95.

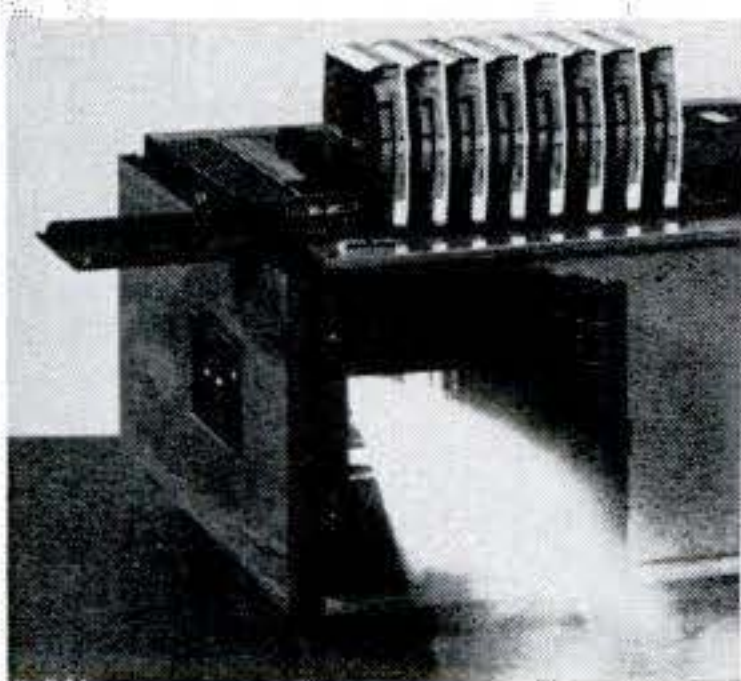
Gas logger

Weight is low—and so is the price—on Remington's new Mighty Mite Bantam. The little saw weighs in at 6½ pounds, costs \$99.95. Features include automatic trigger oiling, all-roller-bearing construction, and a quiet, low-tone muffler. It comes with a two-year guarantee.

Electric logger

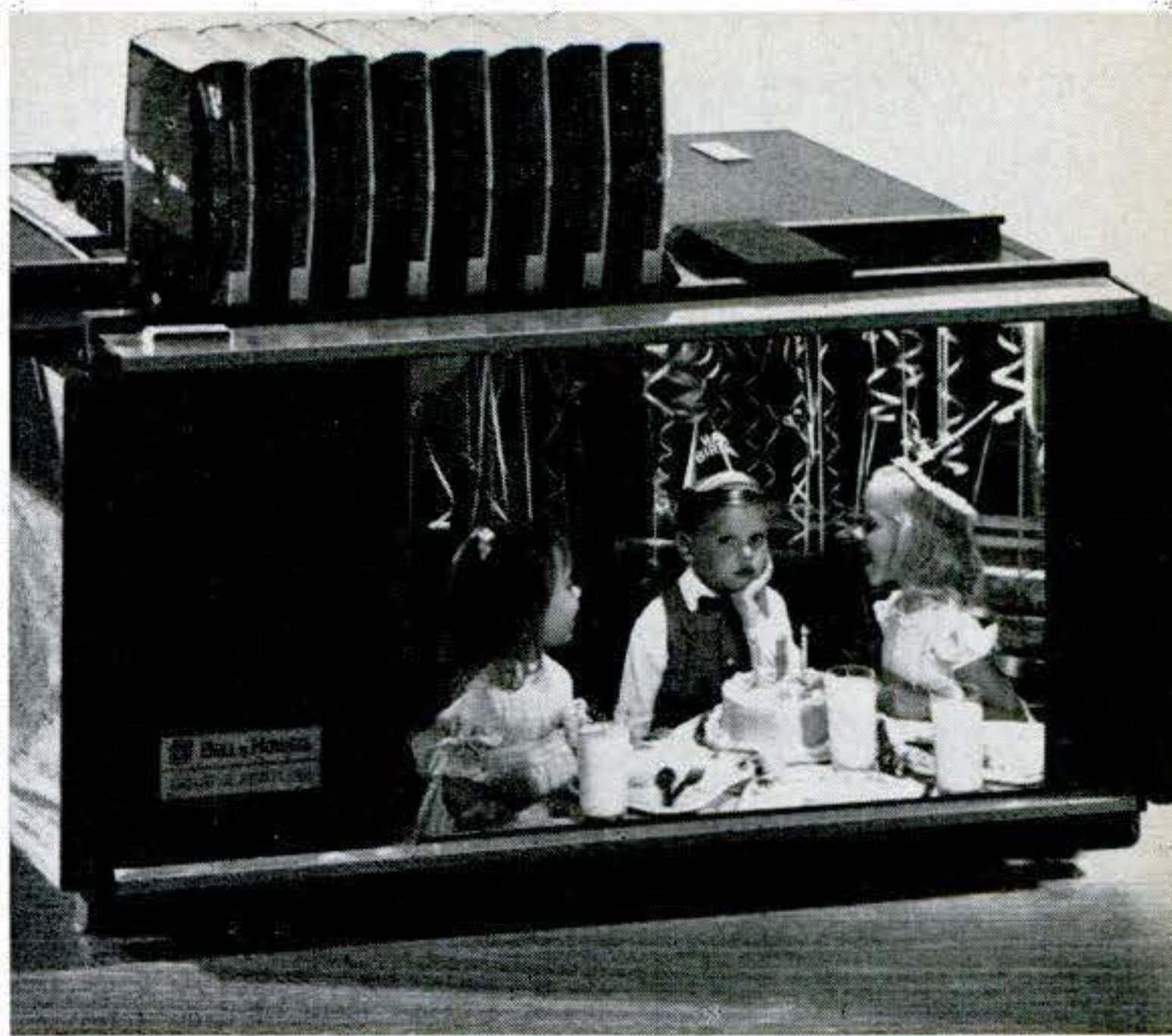
One way around the noise of a gas-powered chain saw is to go electric. A new way to go electric is Sears' line of double-insulated saws. At left is the two-horse model 3416C, with auto oiling and sharpening, and roller bar tip for long chain life. The 12-pound saw is \$97.95.

What's New IN PHOTOGRAPHY



A projector with a built-in movie screen

You can see your movies two ways with Bell & Howell's new Double Feature projector: on the built-in six-by-eight-inch screen (above, right) or, with the lens cover door opened, on a standard projection screen. The projector takes up to eight 50-foot cassettes, automatically threads each into projection position, and rewinds it. Besides standard 18-frames-per-second speed, the top-of-line model 1641 (\$219.95) offers slow-motion six-fpm and stop-motion two-fpm—great for studying your golfing form. Standard model will set you back \$189.95.



Film protector

X rays won't harm your film when you're traveling by air if you put it in a Filmshield bag. The bag consists of lead foil laminated between sheets of polyester plastic. It holds up to 15 rolls of film, or you can put your camera in it. Price: \$3.98.

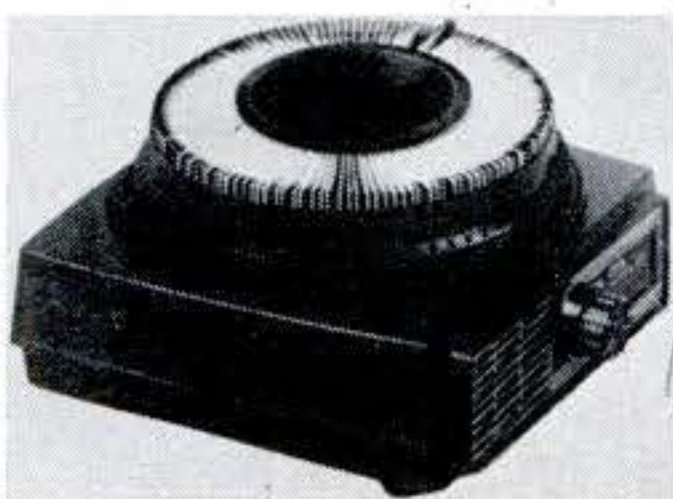


Dodging timer

Like to count seconds when you're burning-in or dodging prints in the darkroom? Plug this little Honeywell-Wein solid-state Micronome into your enlarger timer, and you get an audible pulse every second. It sells for \$14.95.

Flasher

Forget flashcubes. Now there's a pocket camera with electronic flash built in. It's the Key-stone Pocket Everflash, and it comes in three models: 120 (left) for \$54.95; 130, with electronic shutter, for \$69.95; and 140, with a rechargeable Ni-Cad battery and charger, for \$89.95.



Cordless changer

With the Sonar/Matic, you don't need a remote cord to operate your Kodak Carousel slide projector. Plug the transducer into the remote-control socket, squeeze the bulb, and a high-pitched tone—around 20 kHz—activates the changer. Range: 50 feet. \$19.50. Maker: Montage, 9 Industrial Dr., Rutherford, N.J. 07070.

What's New FOR YOUR CAR

Vibration meter

Instantly pinpoint vibration in your car's wheels, tires, or power train? That's what the maker claims for the Vibration Analyzer. Sensors strapped to components signal vibrations to the console. Made for both cars and trucks by Autotherm Div., Walbro Corp., Cass City, Mich. 48726.



Swivel brush

Time to wash the family bus again? This four-way brush on the end of your garden hose makes it easy. The swiveling head locks in position to wash wide flat surfaces or tight corners. A detergent dispenser is built in. About \$10. Master Specialty Co., Savage, Minn. 55378.

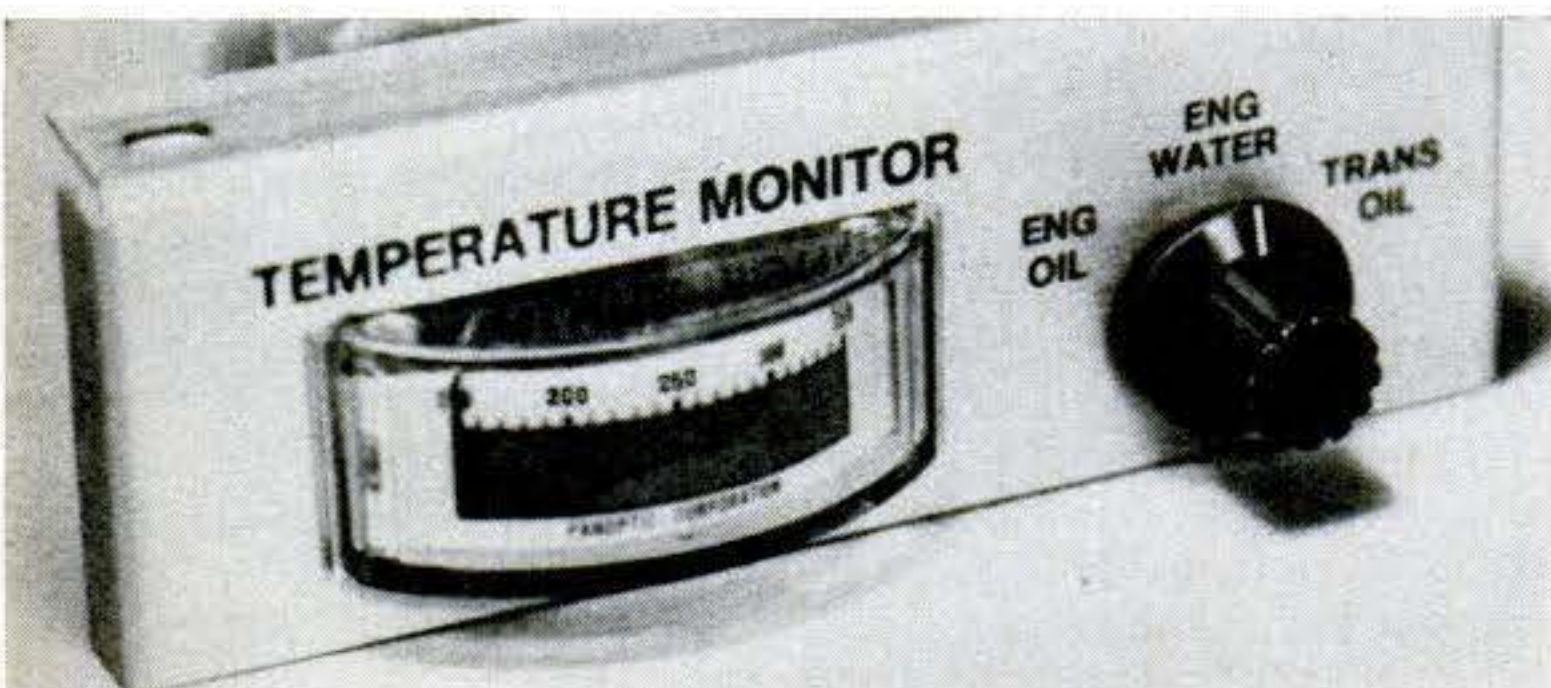


Heat gauge

Now, without drilling holes, you can install a temperature gauge for any heat-producing area of your car. Solid-state sensors, epoxied in place, are connected to a dash monitor. Temperature Monitor is made by Panoptic Corp., 1795 Massachusetts Ave., Riverside, Calif. 92507.

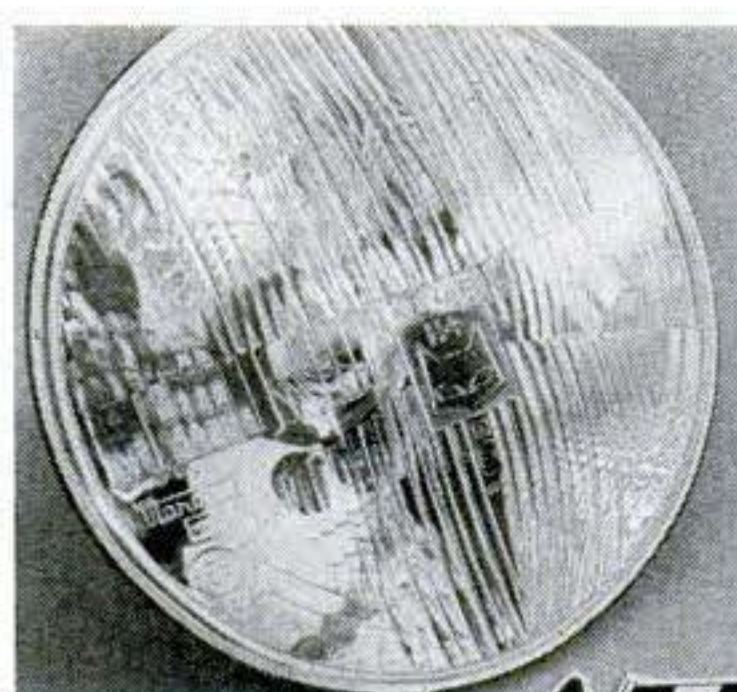
No-care battery

Maintenance-free—that's how General Battery Corp. refers to their new Everful car battery. It can be shipped to dealers in either a wet- or dry-charge state. Once the electrolyte is added, the battery owner shouldn't have to service the battery during its entire life. GBC says it'll be on sale soon.



Rayon radials

Marketed in the U.S. as Veloce GT radials, these new tires are made by Dunlop. They're not steel-belted, but use rayon cord for both belt and carcass plies (like the Pirelli Cinturato). PS Automotive Editor Jan Norbye tried a set of Veloce tires on a Fiat 124 sport coupe that originally had Pirelli tires. His report: "Compared with the Pirellis, when new, the Veloce tires have the same excellent wet-traction characteristics, good sidebite on dry roads, and quiet ride. Tread life? It's too early to tell, but indications are they'll last longer than the Pirellis."



Conversion lamp

A low beam that gives glare-free performance in fog, a high beam with coverage and intensity double that of stock headlamps—that's the Iode H4 iodine headlamp. It's a bolt-in replacement for a standard lamp. They're \$44.95 a pair from F & W Rallye Engineering, 5N775 Campton Ridge, St. Charles, Ill. 60174.



Adjustable shocks

Turn a dial on a dash-mounted regulator to adjust the rear ride height of your car. That's all you do with Delco's new adjustable rear shocks. They're designed to add extra muscle over the rear wheels when you're carrying heavy loads or towing trailers. \$80 buys a Jac Pac 175 kit.

What's New

IN HOME IMPROVEMENT



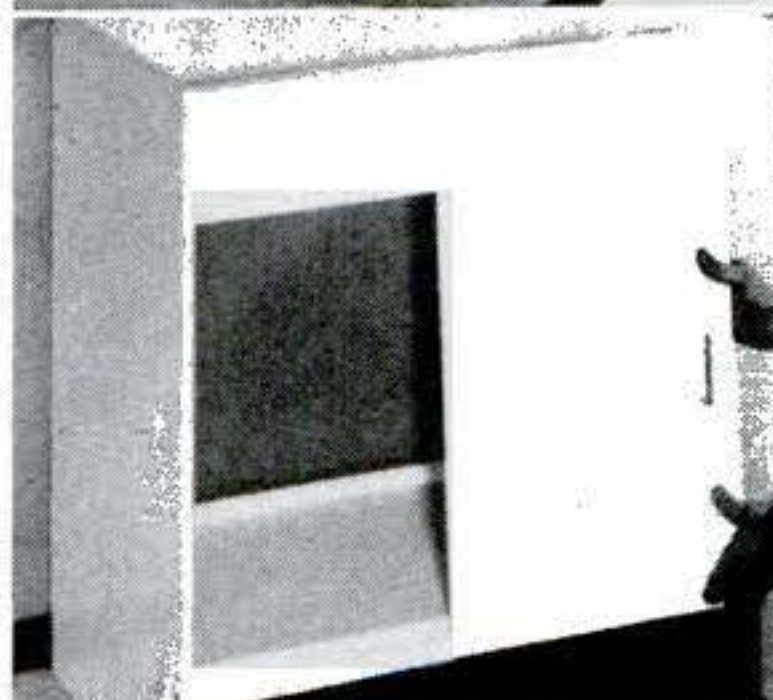
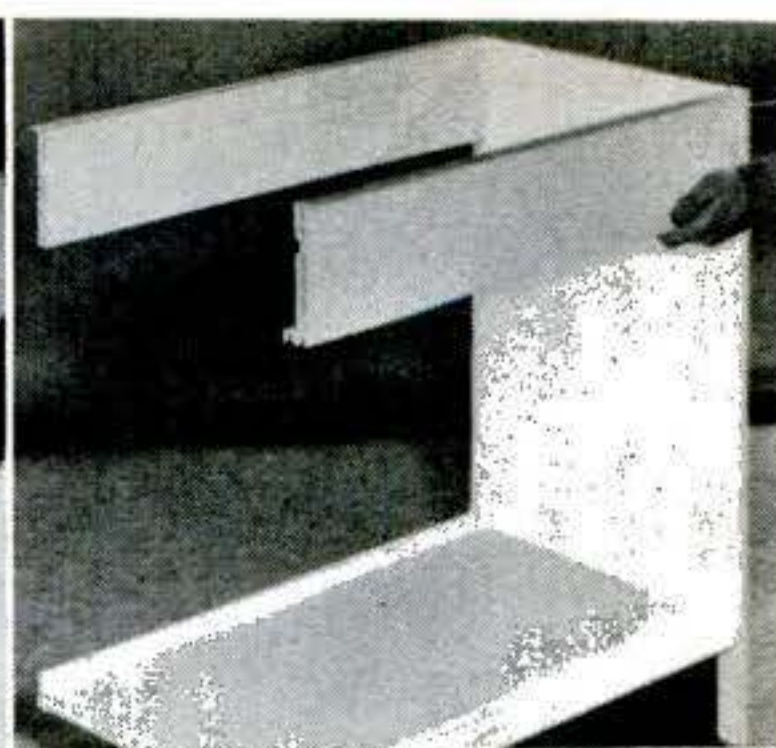
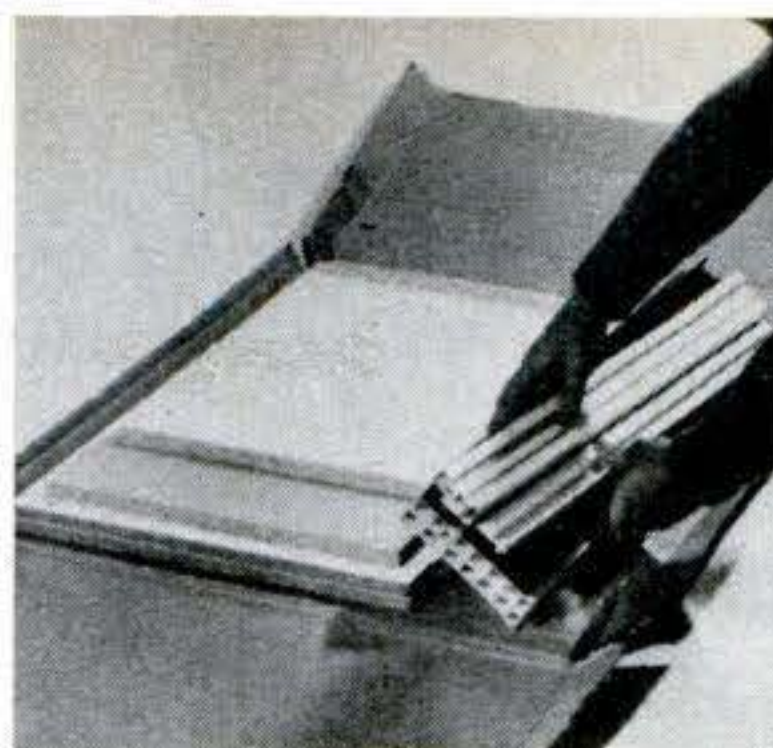
Space saver

GE's new plug-in timer won't take up counter space—it plugs right into wall outlets. It controls appliances up to 1800 watts, lamps up to 840 watts. Just plug them into the front of the timer. Has manual override feature, too. Height: four inches, width: 2 $\frac{3}{4}$. Color: beige. Price: \$7.98.



Curtain keeper

No more water on the bathroom floor with Shower Sentry. Cement it to your bathroom wall and it keeps the shower curtain wall-to-wall tight. It opens and closes with the flip of a finger, grips all kinds of curtains without damage. Scott Machine Development, Walton, N.Y. 13856, makes it.



Modular kitchen cabinets from Germany

Here's the latest idea in modular kitchen cabinets. A German firm—Schock & Co.—has come up with a simple system that can create a variety of cabinets from just four extruded plastic profiles, and some laminate-coated particle-board. Above, a sink cabinet goes together in minutes. Advantages of the system? It's cheap and easy to produce, package, transport, and install. At present, the Germans see the new cabinets mainly as grist for the low-cost, high-volume housing trade, but its simplicity could make it a boon to the do-it-yourselfer, too.



Two-in-one paint

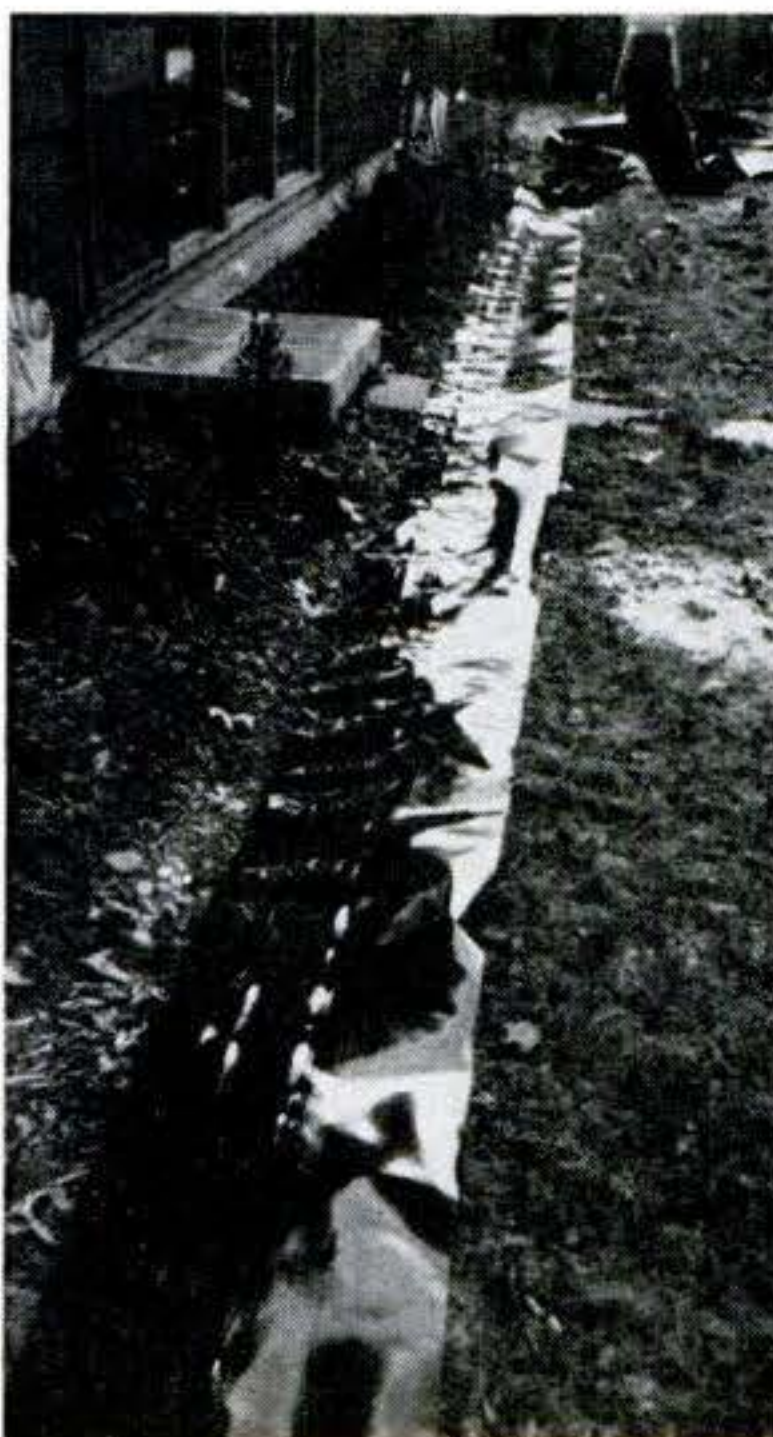
No need for two types of paint with Flat 'n Satin. It combines the appearance of flat wall paint with the durability of enamel—so it's good for both walls and woodwork. Sapolin guarantees one-coat coverage and five-year washability with household detergents. Drying time is about 20 minutes.

Instant dike

Fight water with water—that's the idea behind K-Dike. You set the water-inflated plastic flood barrier—10 inches high and 150 feet long—around your house. Price? \$36, from K-Industries, 560 Market St., Newark, N.J. 07105.

Airtight case

Savogran's Tile Grout is just the ticket for home tile repair jobs. The resealable plastic containers—one- and five-pound sizes—assure that the product won't dry out on your shelf between jobs. The grout is a white water-mix formula that's good when you're installing new tile, too.



SCIENTIFIC FACTS BEHIND The Hassle Over Atomic Energy

We need more electrical energy desperately, and some experts are boosting nuclear plants as the best bet. But critics insist that the risk is too great

By EDWARD EDELSON

There is a debate raging in this country that could be the most important one of your life: Is atomic energy safe?

The answer is made critical by our burgeoning energy crisis. It is also urgent, for the nuclear age is here . . . and now. Some 30 nuclear plants with a generating capacity of 15,500 megawatts of electricity are already in operation. Being built or planned are 135 more, with a capacity of 132,300 megawatts. The Atomic Energy Commission projects that by 1985 the atom will provide 10 percent—and by 2000 perhaps 30 percent—of our total energy needs.

But the road to this rosy nuclear future is not clear. Serious scientific and technical questions have been raised about the safety of nuclear generating plants.

Charge and countercharge. Critics say that the AEC has not done enough to insure the basic safety of these plants, and that there is disturbing evidence indicating that the emergency safety systems designed to avoid major accidents might not work when they are needed. Such prominent figures as Ralph Nader and Senator Mike Gravel of Alaska say that the evidence of laxity by the AEC, the builders of nuclear plants, and the electric utilities is jarring enough to warrant a moratorium on construction of nuclear plants.

The pro-nuclear reply is that quality control is good enough, that the emergency systems will work if they are needed, and that the fears expressed by critics are far out of proportion to the real risks. If the worst fears about the safety of today's nuclear plants are true, this nation could be in the biggest bind of its history.

The reason is that geothermal power, solar power, fusion power—no matter how promising—aren't expected to fill our energy gap for decades. And your job and standard of living depend on an adequate, if not abundant, supply of energy.

How justified are these safety fears? In two words, nobody knows. At this stage of the game, it's all a matter of educated guesses. Since the reactors being built today are two and three times bigger than any in the past, there is no solid data on long-term operating experience. Since no emergency system for such a reactor has ever had to meet a full-fledged crisis, no one can say for sure what would happen.

Nevertheless, each side has scored its points. Critics have cited evidence that some safety experts within the AEC have been deeply unhappy with the safety research program—charges that the Commission has tacitly admitted by internal shakeups and by moves to tighten the standards it once said were perfectly adequate. On the other hand, AEC regulatory officials stolidly point out that whatever its deficiencies, the safety program thus far has prevented any major accident (although they acknowledge that they cannot insure that the same thing will be true when many more reactors are operating for much longer periods).

What's the meaning? To understand the dimensions of the debate, you need a working knowledge of the innards of what physicist Ralph Lapp calls "the most complex large technological apparatus we have ever built"—the modern nuclear generating plant.

To oversimplify grossly, these plants have two key ingredients: fuel to produce heat and coolant to transfer heat. The fuel, of course, is uranium. The coolant for almost all nuclear plants built in the United States is ordinary water—"light water" in industry jargon. (A high-temperature gas-cooled reactor is also available, but relatively few have been sold.)

There are two kinds of light-water reactors. One type, built by Westinghouse, Babcock & Wilcox, and Combustion Engineering, is called a pres-

surized water reactor (PWR); the other type, built by General Electric, is a boiling water reactor (BWR).

Both BWR and PWR use the same kind of fuel: pellets of uranium dioxide, containing about three percent U-235, formed in a hydraulic press and ground to close tolerances. Each pellet is a cylinder about a half-inch in diameter and a half-inch long—slightly smaller than the tip of your little finger.

These pellets are inserted in a long seamless tube, made of stainless steel in the earlier days, but now made of an alloy called zircalloy. Each fuel rod is about 12 feet long with a 0.003-inch gap between the pellet and the cladding. A light-water reactor may contain almost 40,000 of these rods, with about 100 tons of uranium dioxide.

That may seem like a frightening amount—enough U-235 to make 100 atomic bombs—but no one is worried about a nuclear plant exploding like a bomb. It can't happen because the three-percent U-235 used in nuclear fuel doesn't do what the nearly pure U-235 in a bomb can do: Even the most severe critics of nuclear safety dismiss that possibility out of hand.

Runaway radiation. What they're worried about is the possibility that the nuclear fuel might get hot enough to melt and escape its containment, thus releasing vast amounts of deadly radiation to the atmosphere. That danger involves the other key ingredient of a reactor, the water that acts as coolant.

In both BWR and PWR, the essential activity is the same: heat produced by fissioning uranium turns water into steam, which then turns a turbine to produce electricity.

In the PWR, this is a two-step process. The core of the reactor is one big bundle of fuel rods. Water comes in from the top and makes a U-turn upward through the fuel elements. The water is held at a pressure of 2250 pounds per square inch, which means it can be heated to approximately 600 degrees F without turning to steam. (The surface temperature of the fuel rods is about 600 degrees, although the center of the pellets may reach a near-molten state at 4100 degrees F.) This pressurized water then is piped into a steam generator, where its heat is transferred to a secondary loop. Water in this second loop is turned into

Safety

steam, which turns the generator.

The boiling water reactor uses a one-step system. Water at 1000 pounds per square inch is piped into the core, where the fuel rods are collected in several hundred bundles. The water flows in channels between the bundles, is heated to 545 degrees F, turns into steam, and flows directly to the turbine. It is then condensed to start the cycle again.

In the safety debate, the key fact about the water in both BWR and PWR is that it has a double function: Not only does it transfer heat to the turbine, but it is also used as a coolant, keeping the core bundles of fuel elements at the desired temperatures. The nightmare that everyone fears is a LOCA—"loss of coolant accident," in which the reactor core suddenly loses its water and quickly becomes catastrophically overheated.

Versions differ. The scenario for a LOCA has different outcomes for AEC people and for their critics. But the story has the same starting point: what the experts call a "double-ended guillotine break" of the largest pipe in the coolant loop—in other words, a complete snap that severs the pipe like an axe, sending water gushing out relentlessly at high pressure.

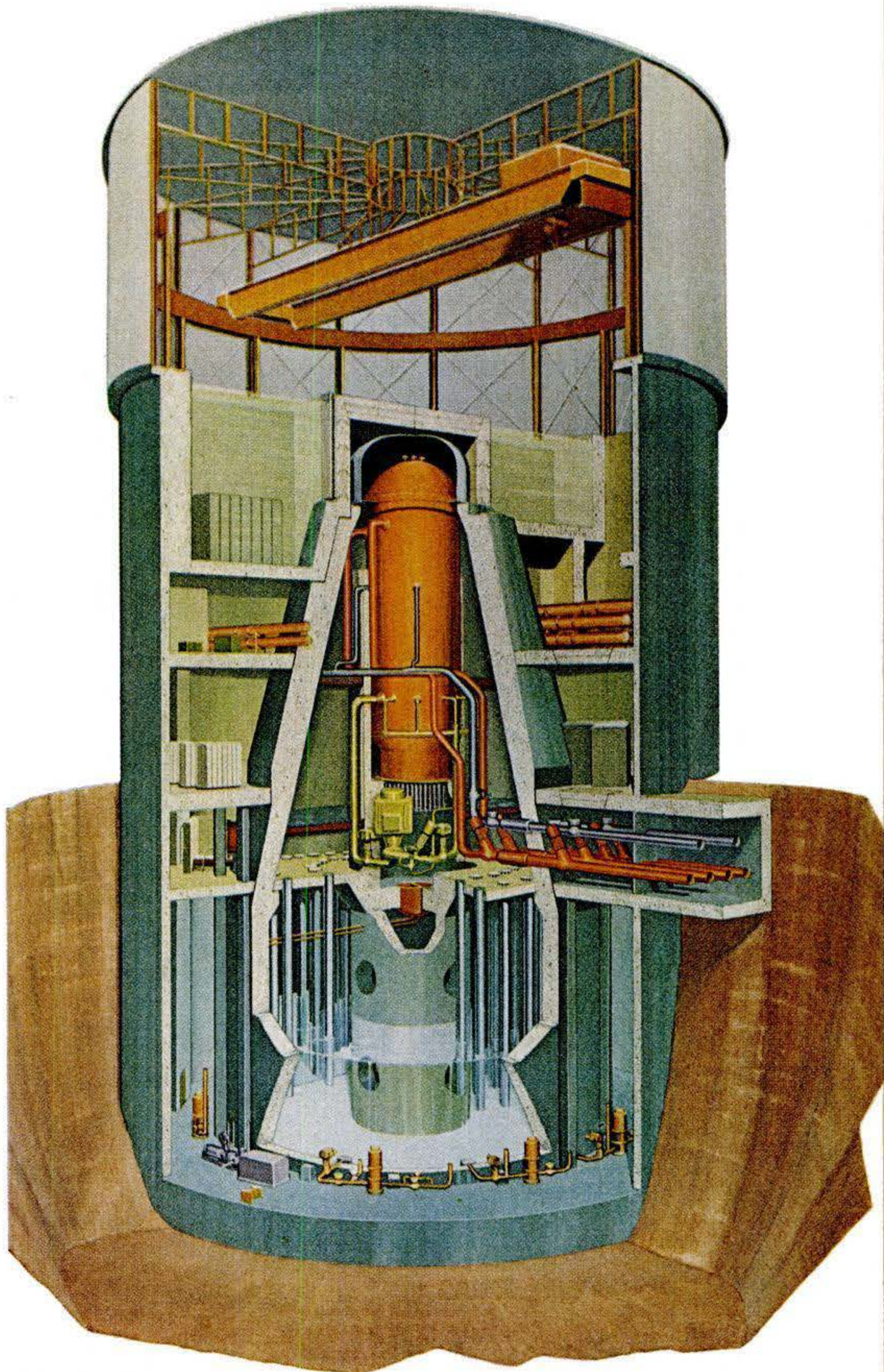
The AEC claims that after such a break, the ECCS would work, by flooding the core with emergency coolant. The agency's critics claim that the ECCS would fail, because the coolant would never reach the core. (For a blowdown-by-blowdown description, see the illustration on pp. 80-81.)

If the critics are right, this is what would happen:

The core temperature would rapidly rise to a point where, at about 2700 degrees F, the chemical reaction of zircalloy and steam changes; instead of being cooled by the steam, the alloy is heated by a chemical reaction that liberates hydrogen, creating additional heat to be removed. The core gets hotter.

In a matter of minutes, the core has reached a temperature over 4000 degrees, and it melts, forming a glowing, radioactive ball weighing 100 tons. To contain the high pressure of the core, and for safety's sake, the nuclear innards of the reactor are contained in a huge pressure vessel of carbon steel, six to eight inches

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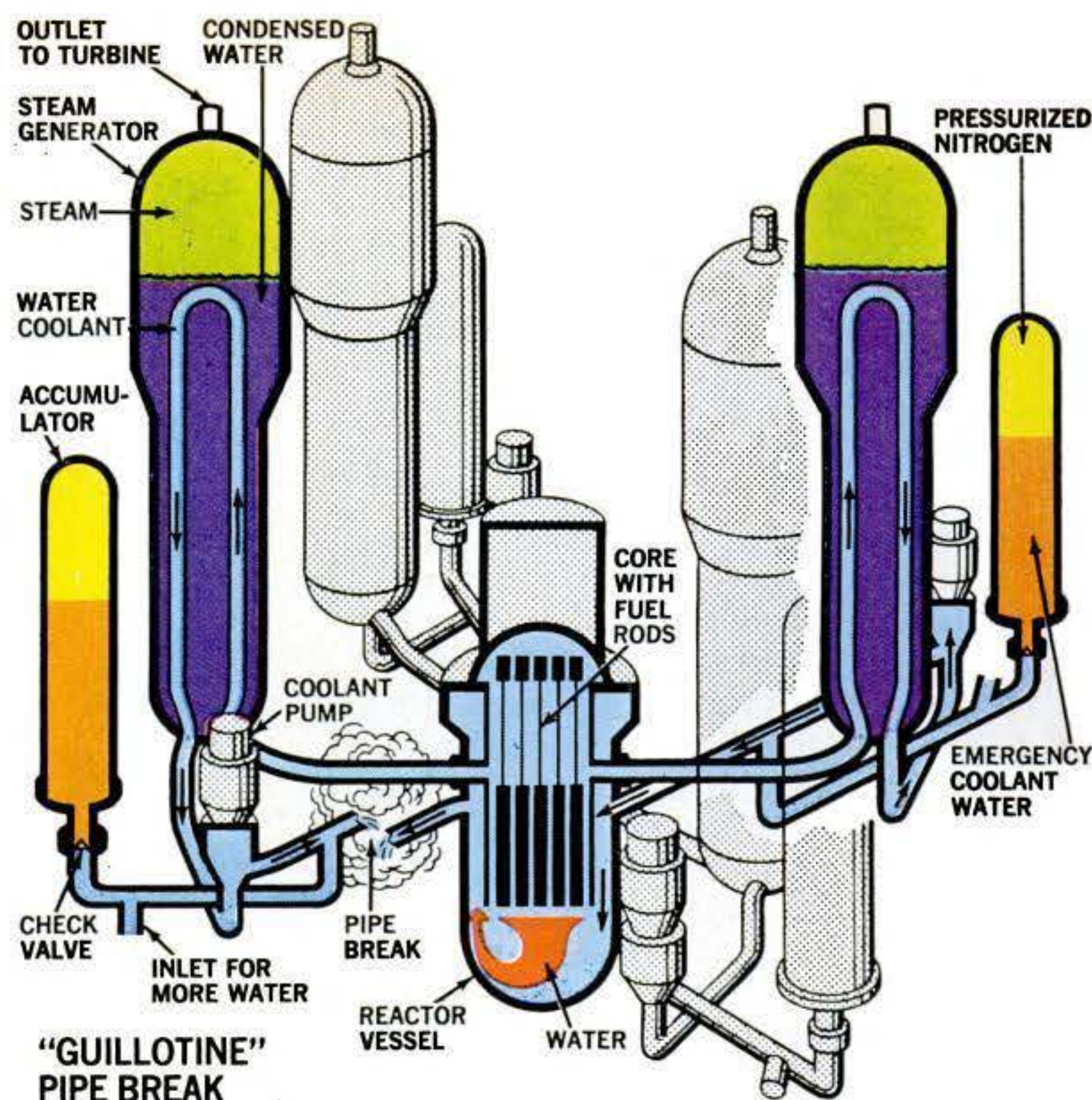


The boiling water reactor (BWR) heats water in its core, then sends the steam directly to drive turbines, unlike the pressurized water reactor (next page), which uses an intermediate steam generator. This design, GE's containment concept, has several emergency cooling provisions. If there is a break in the pipes delivering cool water to the reactor vessel (orange tube), any of four detectors inside the vessel sense a drop in water level there. They signal high-pressure pumps to turn on and deluge the core with water through a sparger system—a kind of high-powered sprinkler system. Simultaneously, a low-pressure pump sys-

tem floods the core with water. As this mass of water hits the hot core and carries away the heat, it is converted into steam, so the pressure begins to rise rapidly inside the containment vessel (conical gray shell that is cut away in this painting). This rise in pressure (and temperature) is moderated by a suppression pool—the large pool of cool water at the bottom of the containment vessel. As the heated steam expands, it bubbles down through the pool of water and is cooled, so the pressure drops. The heated water from the suppression pool can later be pumped through heat exchangers to restore it to its proper temperature.

If the worst happens, will an emergency cooling system keep all hell from breaking loose?

Loss-of-coolant accident—LOCA—is most feared possibility for nuclear plant designers. Here a pressurized water reactor is shown with its emergency core-cooling system. The ECCS is designed to prevent catastrophic overheating of the reactor core in the event the core suddenly loses its coolant water because of the worst accident conceivable, "guillotine break" of the largest pipe in the coolant water loop. Just after the PIPE BREAK, water is gushing out of the breach from both the reactor and the coolant system. Instantly, control rods slam home in the core, damping the fission process, and the ECCS goes into action, releasing cool water stored in accumulators for just such an emergency. In the AEC SCENARIO, the system works: The check valves open, allowing pressurized nitrogen gas (at 600 psi) to force water out of the accumulators and into the core through the unbroken pipe lines. This water fills the bottom half of the reactor and cools off the core. But in the CRITICS' SCENARIO, by the time emergency coolant water gets to the core the temperature has risen so high that the water turns to high-pressure steam, either blocking more coolant or forcing it to exit via the pipe break, so that the core overheats disastrously. Result: the breakout of a molten glob of radioactive material.



thick; it is calculated that the molten core will melt through this container in about half an hour. The cooling system is contained in a structure of reinforced concrete, perhaps three and a half feet thick, with a steel liner and a nine-foot-thick concrete slab at its base; the molten core will break through this slab in about a day.

The "China syndrome." No one really knows what the ultimate damage would be. Much of the radioactive fission products in the core are gaseous isotopes—xenon, krypton, iodine—and vast amounts will be liberated. Solid isotopes such as strontium-90 could be splattered out of the plant. The core itself, it is assumed, eventually will form a molten glob and sink—toward China!—somewhere under the surface.

Can it ever happen? The critics say such a scenario is uncomfortably probable. The AEC says disaster is highly improbable for two reasons: First, the odds of a double-ended guillotine break ever occurring are extremely small; and second, the odds that the ECCS will work are high.

The AEC's first line of defense is its quality-assurance program—a program designed to insure that as little as possible goes wrong in any nuclear plant. Regulatory officials say that no conventional power plant has ever been built to the standards of a nuclear facility.

"We completely radiograph all welds," says Edson Case, Deputy Director of Licensing for the AEC. "We have significantly greater

requirements on the pedigree of the pipe and the material from which it is made In service, equipment is inspected by ultrasonic or radiographic means, on a continuing basis. Over a 10-year period, we'll look at everything in the plant. Probability of a failure of a nuclear system vs. a conventional system—in the piping—is a factor of 100 less."

The unit of measurement used in calculating these probabilities is the reactor-year—one reactor in operation for one year. To put that in context, all the commercial light-water reactors now operating in the United States have accumulated 150 reactor-years of experience. By the end of the century, we might have as many as 1000 commercial nuclear plants, which means 1000 reactor-years of experience annually.

Rounding up data on pipe failures in conventional power plants, the AEC projects a break occurring once every 1000 operating years; a complete guillotine-type break occurs once every 20,000 operating years. To calculate the probability of a major pipe break in a nuclear coolant system, the AEC leaves out the extra safety factor of nuclear-grade pipe and simply uses the conventional figures, saying that a small break causing a minor release of radioactivity—one to 10 curies—will occur once every 1000 reactor-years, and that a guillotine-type break that would call on the full resources of the ECCS will occur once every 20,000 reactor-years.

Setting aside the minor accident—which, the AEC says, would release

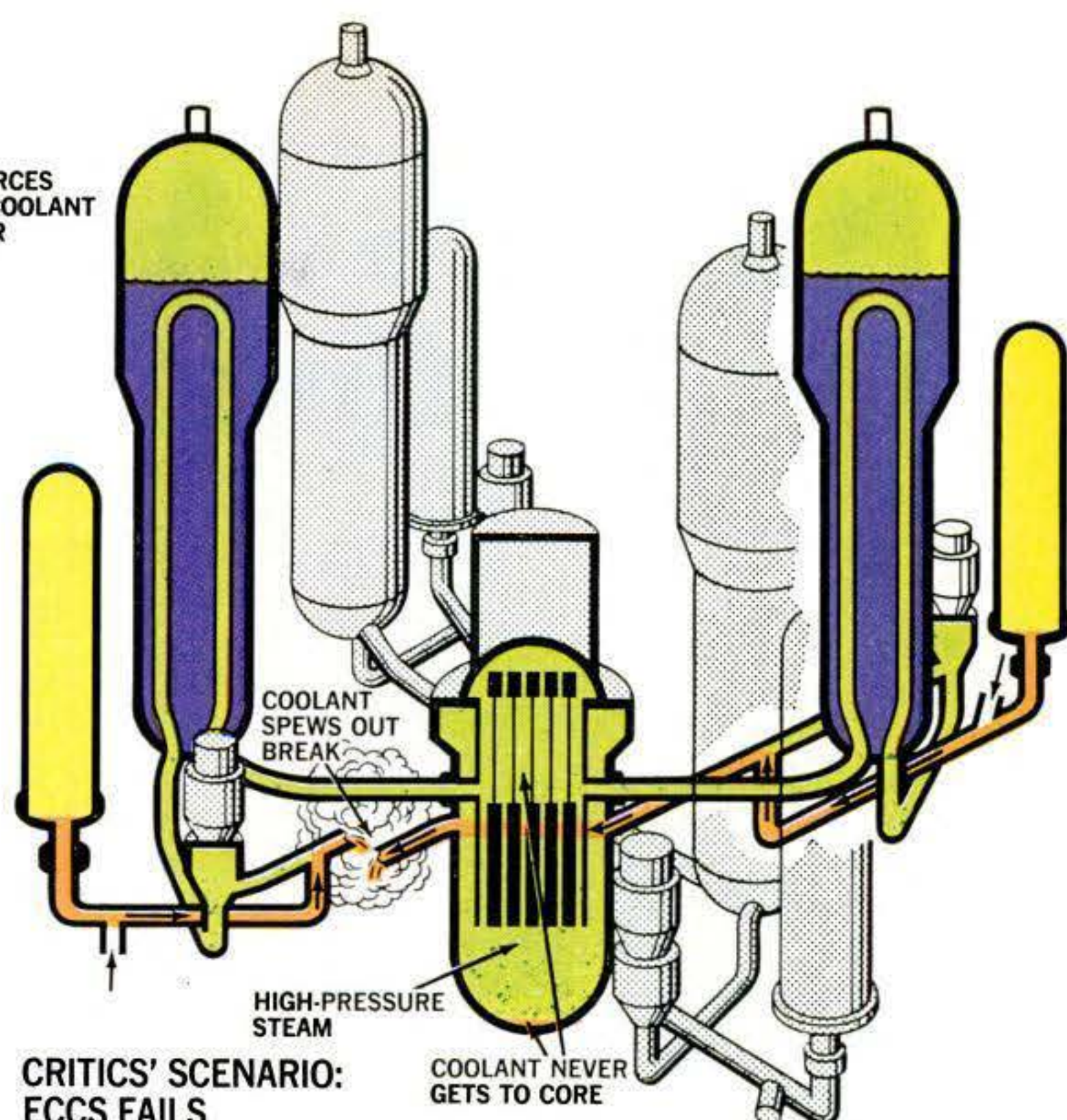
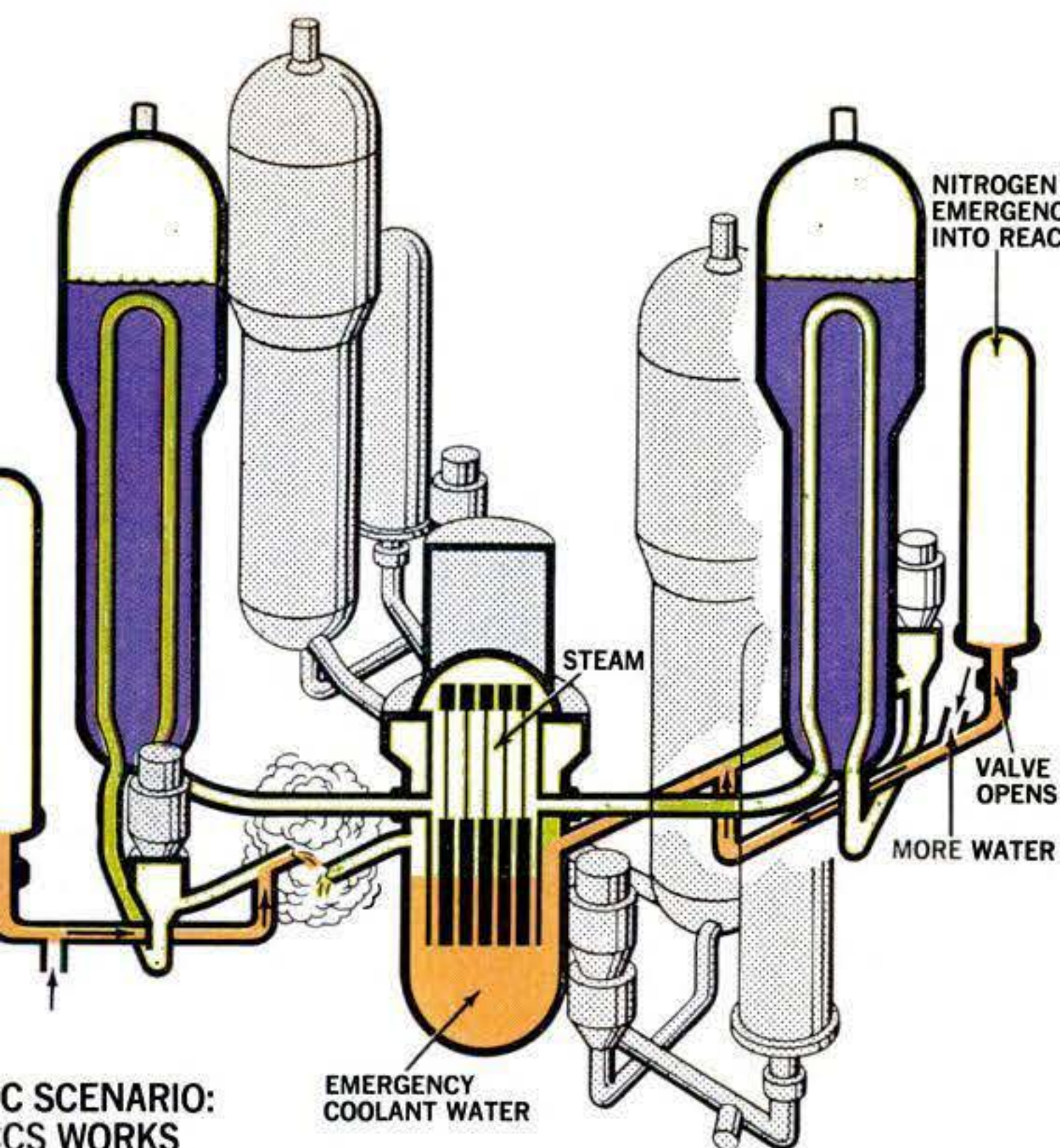
no more radioactivity than is released annually in liquid effluents of light-water reactors—the estimate is that even with 1000 reactors in operation, a major accident requiring an ECCS to go into action would happen only once every two decades.

Critics question those estimates on two grounds: First, they leave out the fact that the new reactors are bigger than any built before, and that this scaling-up in size could produce some unexpected phenomena; and second, that neither reactor builders—"vendors" in industry jargon—nor electric utilities are living up to the high standards of the quality-assurance program.

Reasons for doubt. The first possibility came vividly to life in 1971 when technicians began pulling fuel rods out of the Beznau 1 reactor in Switzerland for a routine refueling. They found that the fuel pellets in a number of the rods had slipped down several inches, and that many of the rods were deformed as a result by the great pressures inside the reactor (but with no escape of fuel).

Not long afterward, technicians refueling the Ginna reactor at Ontario, N. Y., found the same thing—fuel pellets had slipped within the rods, leaving gaps of several inches; dozens of rods were partially crushed, bent and cracked.

An investigation was started hastily, and AEC experts believe they have an explanation. Fuel rods for PWRs today are pressurized with helium. Both plants used older fuel rods that did not have helium pumped in for pressurization. The



DRAWINGS BY HOWARD KOSLOW

fuel pellets inside those rods, by industry custom, compressed to only 92 percent of the maximum density. The extra space, in microscopic pores, is left to allow for the slight expansion that occurs during fission. But heat and radiation inside the core collapsed the pellets, and they slipped down; the unpressurized rods then collapsed.

AEC now says the situation is well in hand. "The fix is obvious," says Edward E. Sinclair, assistant director of reactor technology. "We can't use unpressurized rods. It will be implemented in a couple of years."

Others aren't as assured. "I felt it was another unpleasant surprise," says Ralph Lapp. "Surprises like that you don't want. It's definitely a disquieting thing." The reactors in which fuel-rod crushing occurred are only half the size of the reactors now coming on line, and Lapp and others fear that more disquieting phenomena might be lurking in the bigger plants.

Exactly which problems are size-dependent is an unknown.

What is known is the unhappiness about the way the vendors and the utilities are building and running nuclear plants. "We don't seem to be able to get quality assurance," complains AEC's Ed Sinclair. "This is where we have to spend time, money, and exhortations to industry. We've got to improve the quality of workmanship and the quality of design that real people in real situations are able to produce." The utilities, he goes on, don't seem to have prepared

for the extra complexities of running a nuclear plant.

What this can mean in practice was illustrated by an incident at the 809-megawatt Dresden 2 plant, a BWR, in Illinois on June 5, 1970. It started with a minor malfunction that led to a chain of events—complex but not improbable—that caused damage in the core but stopped short of a disaster. Key equipment did not function adequately, the reactor operator did the wrong thing, there was a glaring error of design in the positioning of a safety valve—but there was no re-

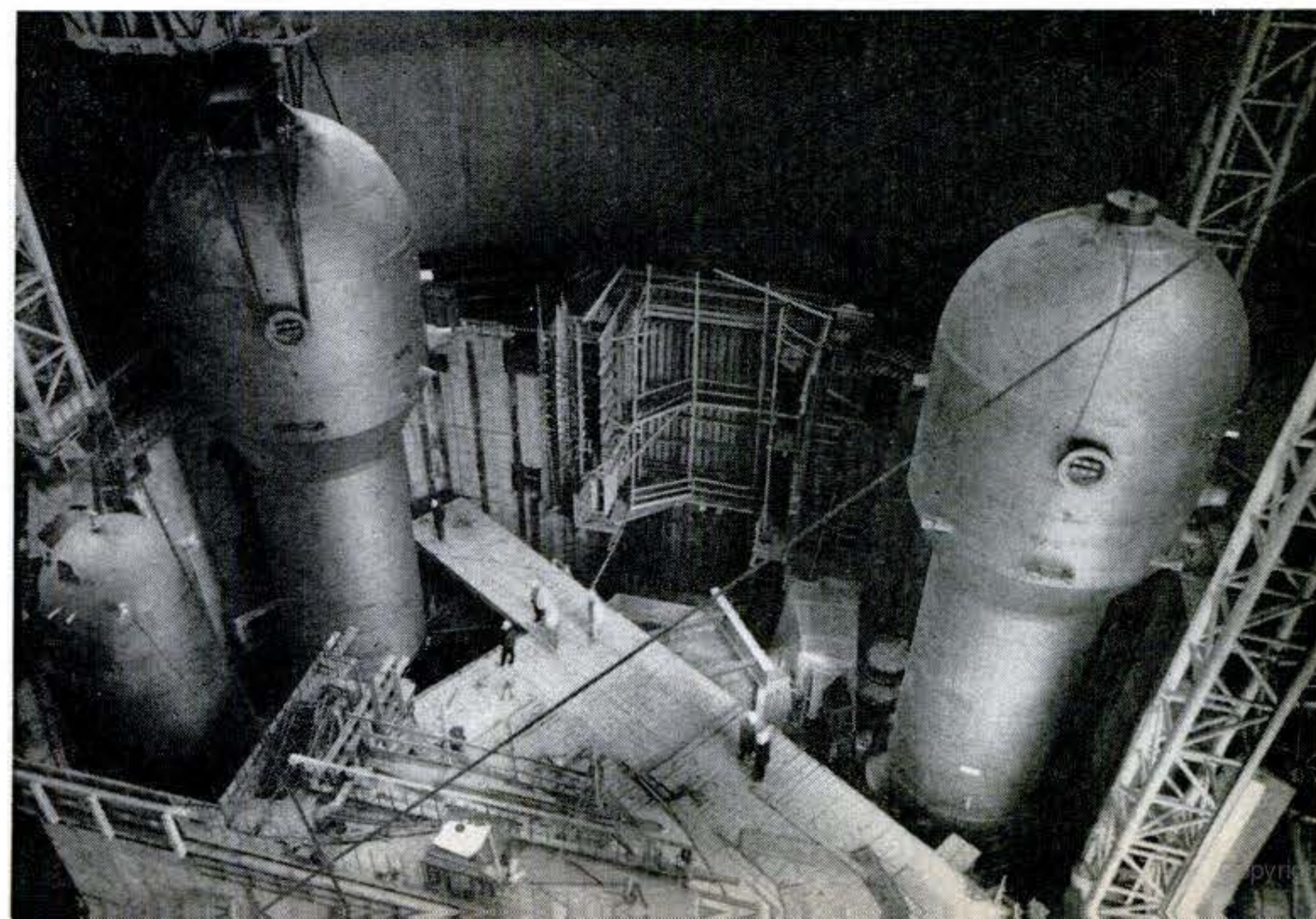
lease of radioactivity outside the plant. The reactor operator, Commonwealth Edison Company, was left with an expensive cleanup job and a need for major revision of operating procedures, but with nothing approaching a major disaster.

AEC regards such incidents as deplorable but perhaps inevitable at this stage of the game. "The industry is only 15 years old," says Ed Sinclair. "We're on a learning curve. It's obvious that these are learning experiences. The industry is so young that some executives don't understand what their responsibility is."

[Continued on page 112]

Enormous scale of pressurized water reactor is shown in view of Baltimore Gas and Electric's Calvert Cliffs Nuclear Power Plant under construction. Two 500-ton

steam generators are in place, as well as one accumulator (part of the emergency core cooling system). The reactor vessel itself had not yet been installed.



Strip Joints: Furniture Refinisher's Best Friend?

Yes and no—it all depends on the particular piece of furniture, the stripper's skills, and the techniques he employs

By JACKSON HAND

Few jobs around the house are more gratifying than turning a time-worn piece of furniture into something worth having, via the refinishing route. But—few jobs are more tedious and messy and dull than removing the old finish.

That's why "strip joints" are springing up all over the country. Take a piece of furniture to a stripper on Monday and pick it up on Wednesday, bare and clean and ready for a new finish. And, putting on the new finish is—for most of us—the fun part.

But, there are some basic decisions to be made first, hinging on the nature of the item to be refinished, and on the stripper's talents and the system he uses. There are several systems—similar in some ways, completely different in others.

How strip joints do it. The basic difference between the stripper's operation and the way you remove a finish at home is: volume of liquid. The stripper has a tank full of remover—sometimes a tank as big as four by eight feet, and four feet deep. He dunks the item in the tank, turns it over a few times, perhaps nudges it with a soft brush or a

scouring pad or steel wool. In a half hour or so—regardless of the size of the piece—the finish is off.

A variation of the dunk system is flooding the finish by means of a hose (next page). A pump recirculates the liquid. The stripper turns and manipulates the piece, repeatedly flooding the surfaces, usually using a brush, fine steel wool, or other method of speeding the chemical action of the liquid. Most hose-off systems also include soaking tanks for the most stubborn finishes.

Strip joints use one, or both, of two chemical systems. The first is a chemical solvent. The other is a hot caustic system. Solvent versus hot caustic is important to you, since certain items should never be dunked in hot water.

Chemical solvent system. This system requires materials very similar to those you buy at paint stores. One common chemical is methylene chloride—a strong solvent mixed with other ingredients in the pro's tanks. Another formula is based on xylol and dimethylformamide. It differs from the methylene chloride formulas in that it is highly volatile and flammable.

As you'd buy these removers, they would include ingredients to make them easier to use—such as thick-

eners to hold them on vertical surfaces, saponifiers to make them water-washable, waxes to retard evaporation, etc. As the strippers buy them, in 55-gallon drums, they don't have these ingredients—either because they aren't needed or because their function is performed in other ways.

There is little to choose between the two most common solvent systems. They both do the job—if the man doing the work is conscientious and capable.

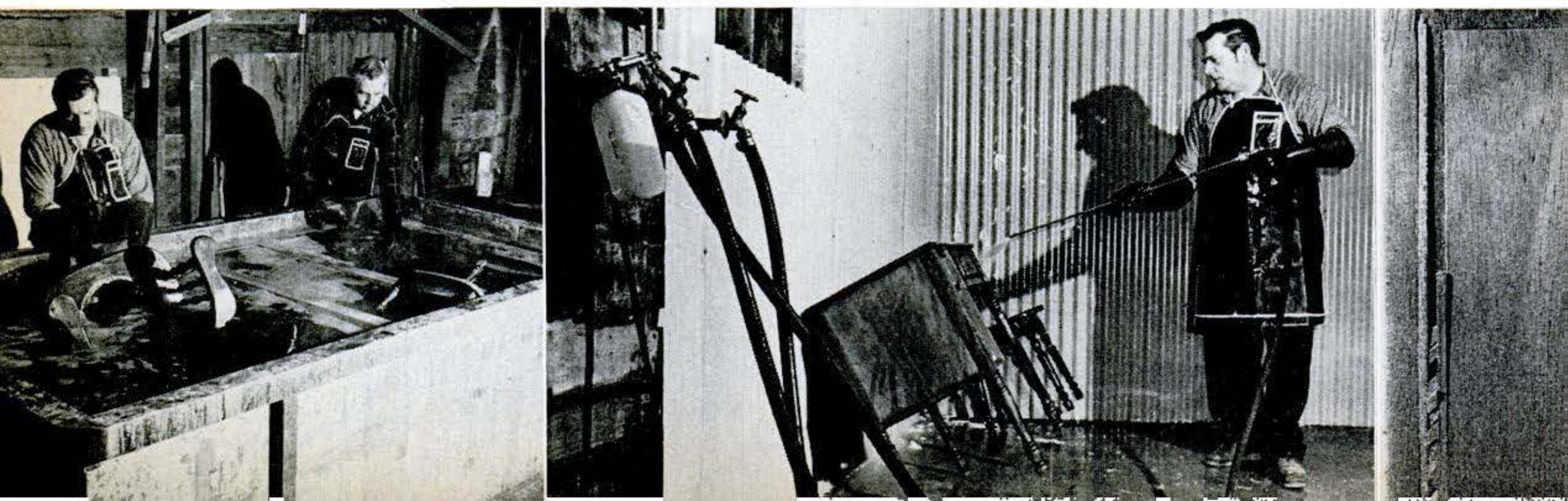
The hot caustic system. This, in basic terms, is a tank of water at about 140 degrees Fahrenheit, in which is dissolved a large quantity of sodium hydroxide—lye. Other caustics may be used, including the relatively gentle trisodium phosphate, but lye is the most common. The combination of heat and caustic makes the solution speedy and effective, but it has deleterious effects on certain veneers and inlays.

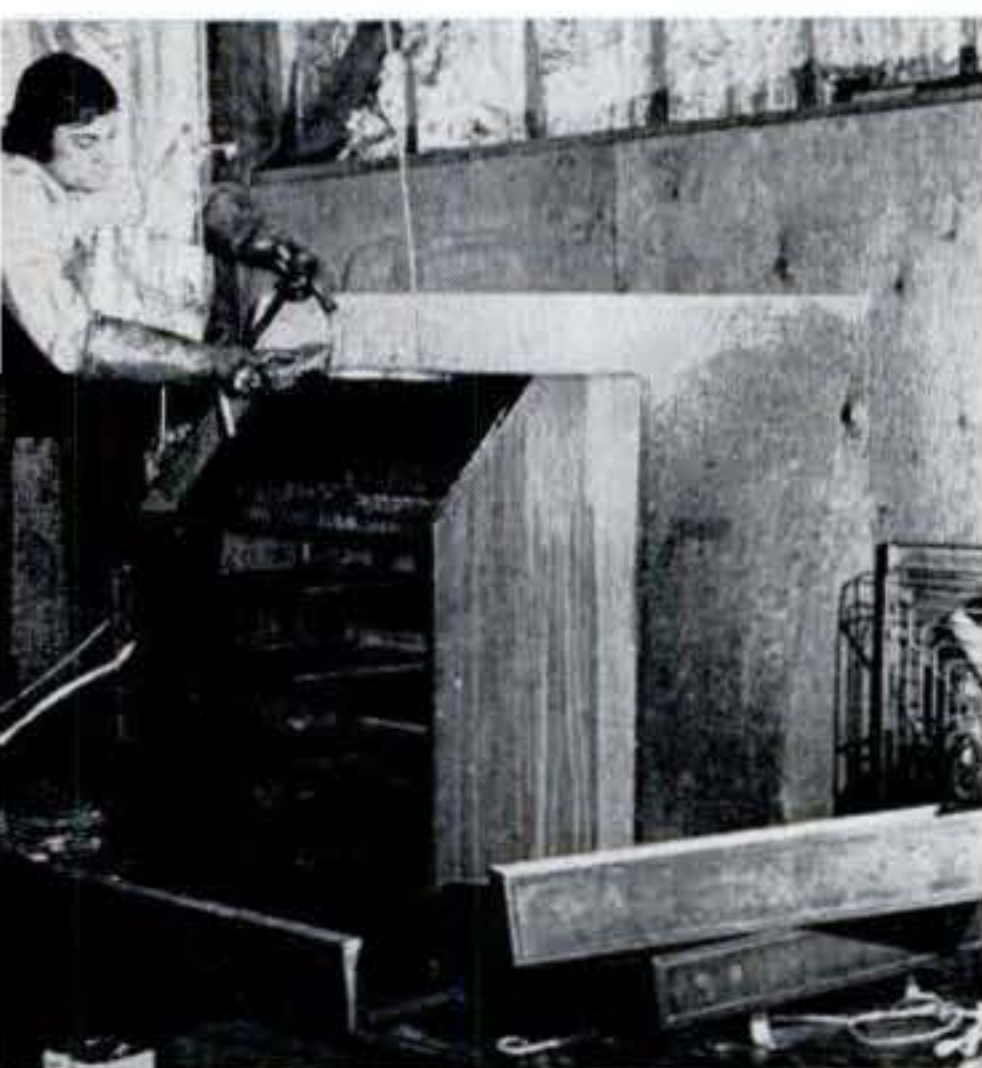
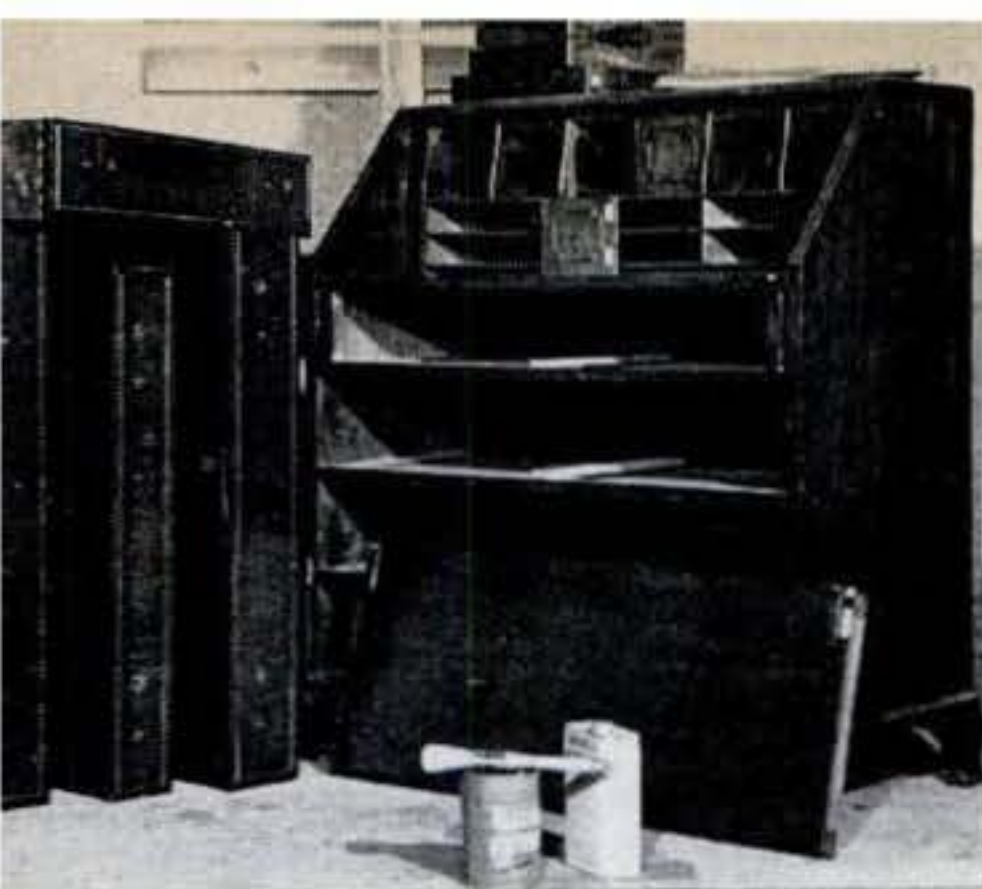
In the caustic system, the piece is first soaked clean in the hot solution, then sprayed with an acid (acetic or hydrochloric) in mild solution. This converts the caustic to a water-soluble salt. Then, the project needs a final water rinse to make it ready for the new finish—after drying and other preparation.

Hot-water caustic stripping uses relatively cheap chemicals which allow use of big tanks and semi-mass-production

process. System requires that caustic be neutralized with acid rinse, then flushed with clear water. Result is usually very

clean, but hot-water stripping is hard on inlays and veneers. Note inlay at right, destroyed by this process.





A professional stripper makes transition from old (top) to new (right) faster.



Just as you can semi-duplicate the effect of solvent systems with store-bought removers, you can also come close to the hot caustic system in home tests. Just make a saturated solution of TSP in hot water, dunk a sample of the project in it for 15 or 20 minutes, then use a vegetable brush to swipe off the softened finish. Of course goggles and rubber gloves are in order here.

Solvents or hot caustics? Although there may be little difference in the job one solvent system does, compared to another, there may be tremendous differences between the results you get from solvents and those from hot caustics. For that reason, there are certain types of furniture, etc., that you should not turn over to a caustic-system stripper. These no-hot-caustics-please types include:

- Furniture with veneers or inlays. The chances are great that the hot water will loosen the veneers—even ruining the piece completely.
- Vintage pieces that are put together with old hide or animal glues. These adhesives are water-soluble, and in a hot caustic the project could literally fall apart.
- Pieces made of coarse-grain, open-pore woods such as oak, lauan, chestnut, etc. The tendency of hot water to raise the grain of these woods may produce extreme sanding-smoothing problems.

On the other hand, the hot caustic system is hard to beat for rough-work projects such as shutters, doors, kitchen cabinets, and other heavy-paint projects.

Since many strip joints use both solvent and caustic methods, you can often leave it up to the pro as to which is best for the specific item. However, since all strip-joint operators may not be equally concerned with your problems (as compared to their motives), it may be best to make the decision yourself.

Which items call for help from the pro? If the piece of furniture is small and simple, you might as well do it yourself. A pint of remover will run you \$1; you'll spend less time on it than you'd spend running it down to the strip joint, where the charge may be \$3 or \$4 or more.

But, there are circumstances that make it more sensible to turn the stripping over to the pro:

- If it's big. A dresser. A dining-room table (pedestals and all). A chest of drawers. A secretary. A four-poster bed.
- Any article of furniture that is heavy with carvings, filigrees, curved surfaces, and spindles. The strip joint's big-tank techniques are much more efficient reaching into crevices and around turnings.
- Any non-furniture items, such as heavily painted shutters or doors,

[Continued on page 127]



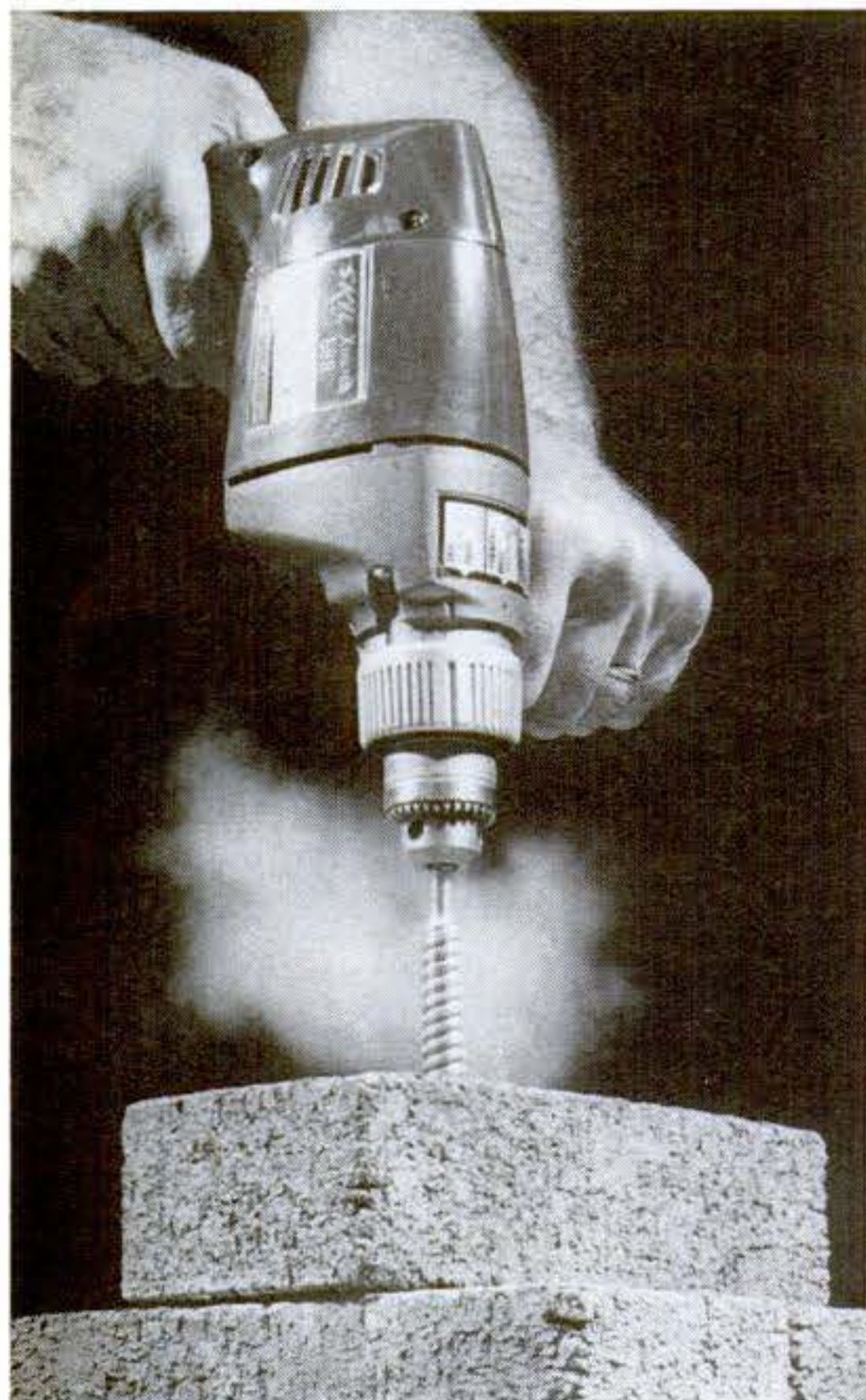
Chemical dunking uses strong solvents like methylene chloride that penetrate a finish and lift it off in sheets. Floating plastic stars in tank, above, reduce evaporation. Huge exhaust pipes and fans (below) keep shop air breathable.



It looks like a drill—but flip the ring and it's an impact tool, too, or a reciprocating chisel

Three-Way Drill Puts Slam-Bang into

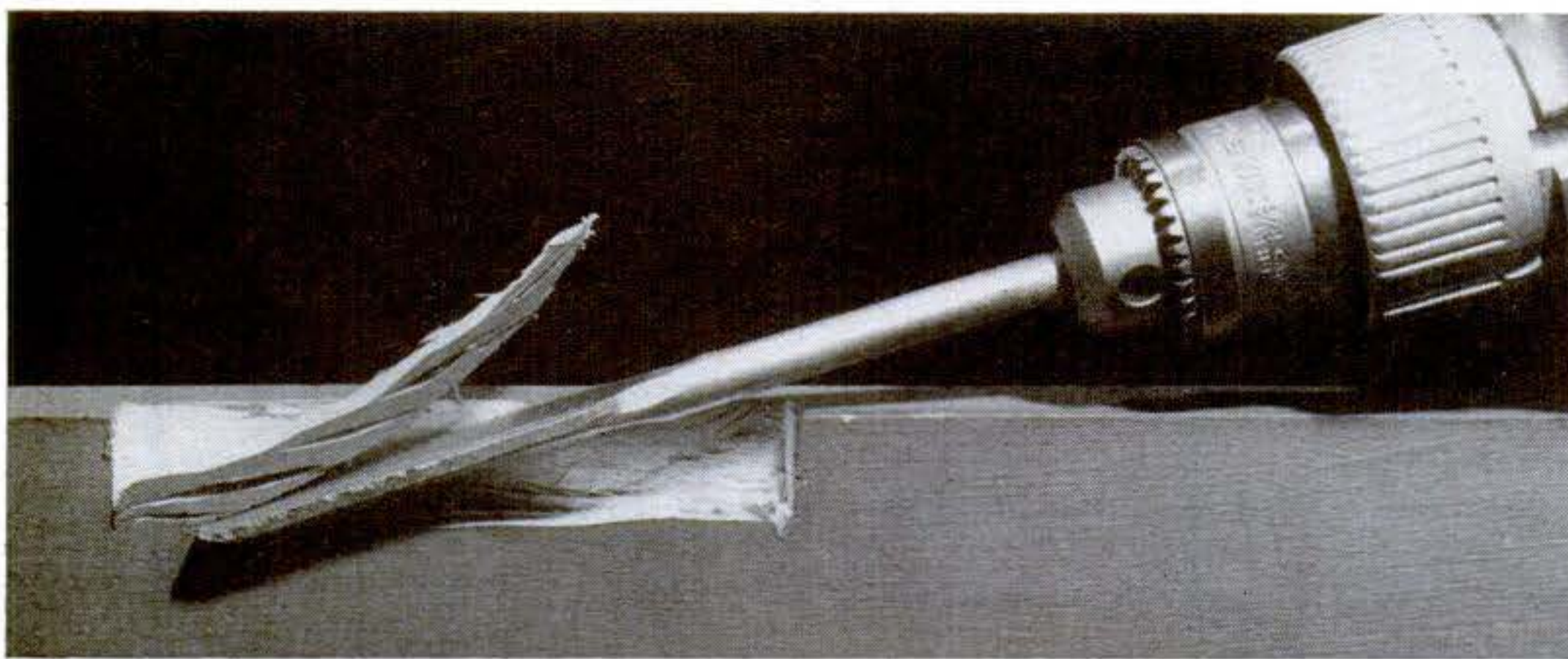
By ROSARIO CAPOTOSTO



Drill-drive (above) is for standard drilling. But for substances like brick, hammer-drill cuts boring time to a quarter.



Hammer-drill is just right for going through this cement block. Time to penetrate 1 3/4": two minutes, five seconds.



Hammer-chisel mode lets you use Xtra tool like a regular chisel. It will take healthy

bites in wood for fast stock removal, although the strokes are short.

I'd always associated impact tools with heavy industry—iron workers pumping away at big rivets or road gangs pulverizing old concrete with jackhammers—until recently. Now a miniature impact tool has entered the domain of home craftsmen, and I say hur-ray!

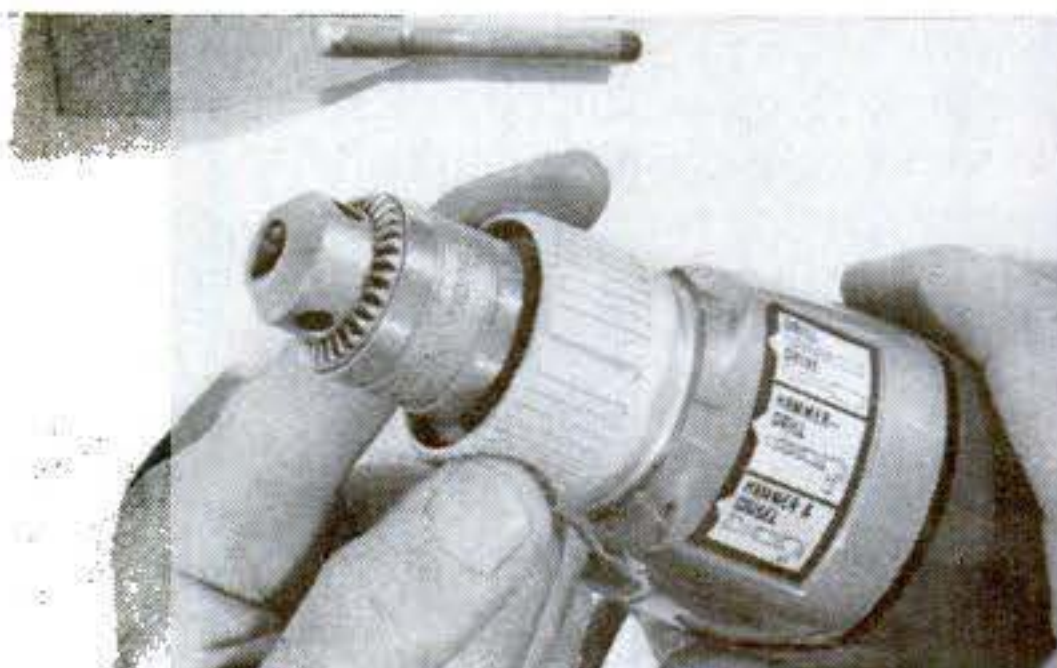
The newcomer is Skil's model 599 3/8" Xtra tool. It looks very much like a conventional drill—which it is—except for an extra ringed bulge between chuck and housing. This is the selector ring, and it gives you not only drill-drive but also hammer-drill and hammer-chisel. A simple twist of the ring clicks it into any of the three modes.

As a basic 3/8" drill, the tool has all the plus features: double insulation, variable speed control from 0 to 850 rpm, forward and reverse rotation, a lock button for continuous operation, a side handle for control. The 115-volt motor is rated at 3.2 amps.

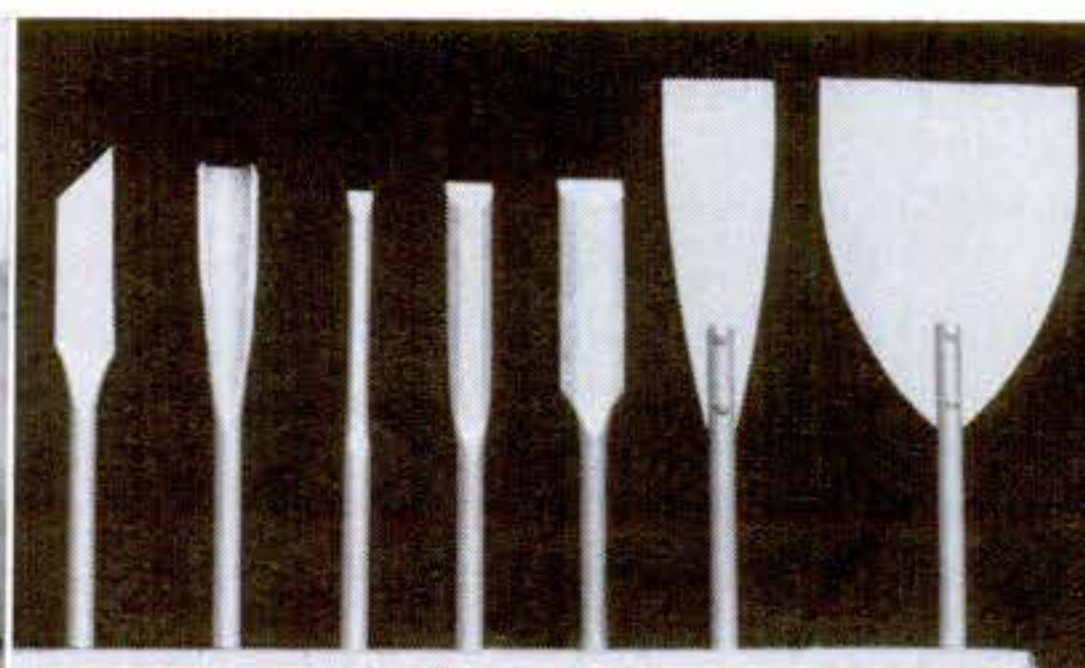
The Xtra tool checked out fine on all the usual drill chores: straight drilling, driving or removing screws, sanding, buffing, and so on.

It's more than a drill. Then I shifted the selector ring to the hammer-drill mode. That turns the action into a combination revolving/percussion motion—dandy for drilling into masonry materials.

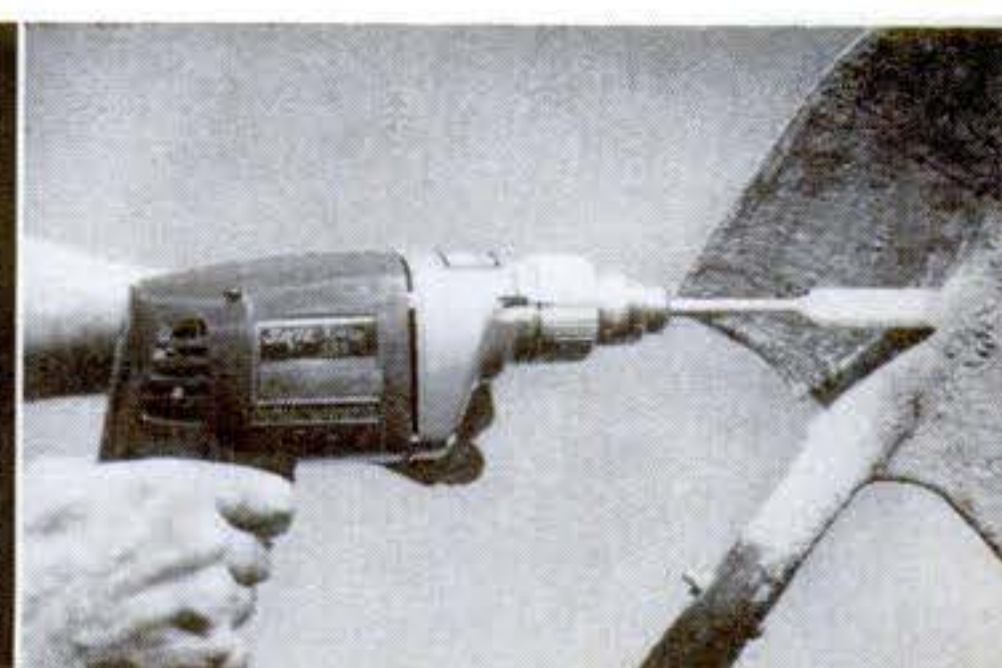
Here's what my comparison tests showed: Using a 1/2" carbide masonry bit, the hammer-drill mode took just two minutes to go through a 2 1/4" brick. In drill-drive, with the same bit and the same brick, the bit penetrated only 1/2" after two minutes. That's a ratio of better than 4:1. I tried



Selector ring clicks into any of the three working modes with just a simple twist.



Accessory tools include chisels and scrapers—all of good quality, author says.



Chipping hardened cement was almost fun in hammer-chisel mode.

Your Work

the hammer-drill mode also on a 1 3/4" cement slab containing pea-size aggregate. Penetration time in this case was two minutes, five seconds.

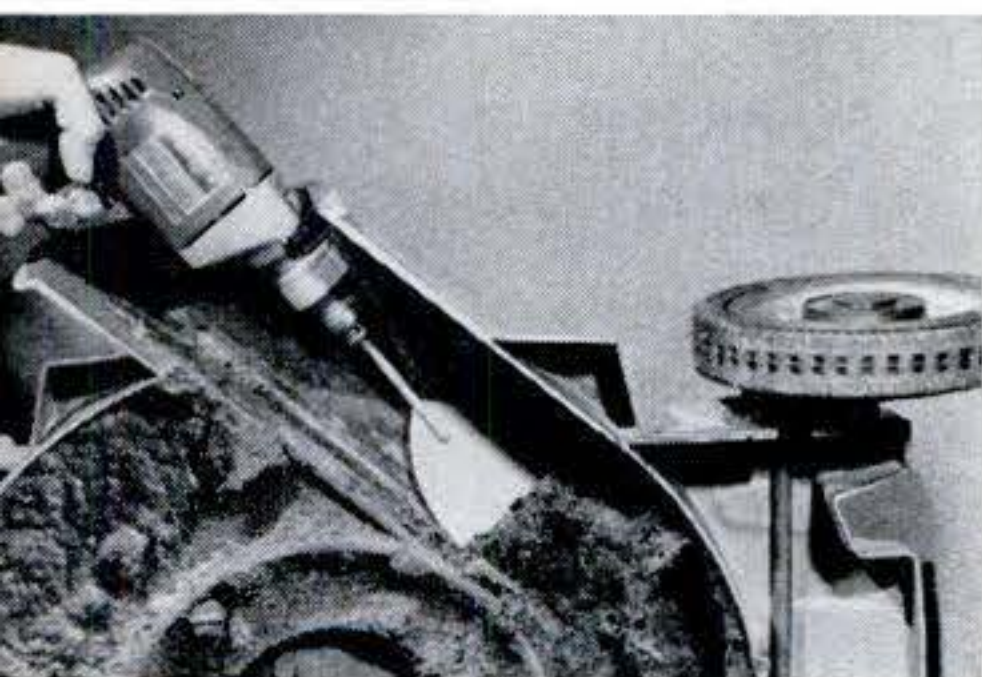
The third function, hammer-chisel, delivers a straight back-and-forth motion, designed for chiseling, chipping, and scraping operations. Accessory tools available for this include flat chisels, gouges, and a pair of flexible-bladed scrapers.

With the speed control set at the maximum 750 BPM (blows per minute), I was able to cut mortise joints in wood or gouge the surface of a board with relative ease and accuracy. The strokes are short. You can feel the vibrations on the housing, but the business end of the tool hardly seems to move.

Other uses, too. The tool also worked well for chipping (although the chisel needed some sharpening after I removed hardened cement from a spade), and as a paint scraper it worked reasonably well. But don't expect miracles. The tool will shave off loose or peeling paint down to a nicely feathered edge, but it definitely will *not* remove paint that is firmly bonded.

Occasionally, when the scraper edge meets too little resistance and slides along the work without hammering, it's necessary, I found, to grasp the scraper shaft to maintain a slight backward pressure and thus engage the slip-type hammering mechanism. No problem, however.

All, in all, I'm quite pleased with the Skil Xtra tool. It's priced at \$49.95. For further information, I suggest that you write to Skil Corp., 5033 N. Elston Ave., Chicago, Ill. 60630. **PS**



Scraping tool is well suited to jobs like this—uncaking a lawn mower.

PERSONAL-USE REPORT

The Extension Phone You Don't Plug In

Take Rovafone with you. No wires—an antenna links you with phone service.



No matter how many extension telephones you have, they never seem to be where you are when someone calls. Sure, they're handy when you're in the kitchen or family room, but what about when you're in the shower? Or the family pool? Or the backyard? With the Rovafone, you've always got a phone at your elbow. You simply carry it with you. There's no cord to plug in.

Even without wires, Rovafone is used like any standard extension phone. You dial to make a call, and use the receiver to talk and listen; and if someone calls you, it rings (actually, it beeps).

How does it work? The Rovafone contains a separate radio transmitter and receiver built into its phone package. Your voice, dial pulses, and ring information are transmitted to and from a transponder unit connected to a standard phone jack in your home. The transponder, a sophisticated transmitter and receiver, relays the conversation from the Rovafone to the phone lines.

Not knowing the proper procedure for checking out a telephone, I decided to turn it over to someone who could give it a rigorous in-use test—my wife.

The test results. Armed only with her mother's phone number, she found that the Rovafone will operate up to 100 hours on one 12-hour charge of its ni-cad batteries. Clarity on both transmitter and receiver was excellent, and she could easily take the phone nearly a block away from home without signal loss.

To conserve batteries, a rear-mounted switch permits you to turn off the phone entirely. This is fine for in-house use when your standard phones can take over.

Rovafone comes complete, including recharging pack, for \$400 from Fonetron Inc., Box 8733, Milwaukee, Wis. 53227. It's perfect for home, or places such as restaurants, golf clubs, boat clubs, and riding stables. A phone coupler is necessary in areas where required by the phone company.—*W. J. Hawkins*



Power switch and antenna are giveaways; otherwise, Rovafone looks like any phone. Antenna extends three feet.



Transponder uses house current for power and simply plugs into standard extension jack. Antenna links it with phone.

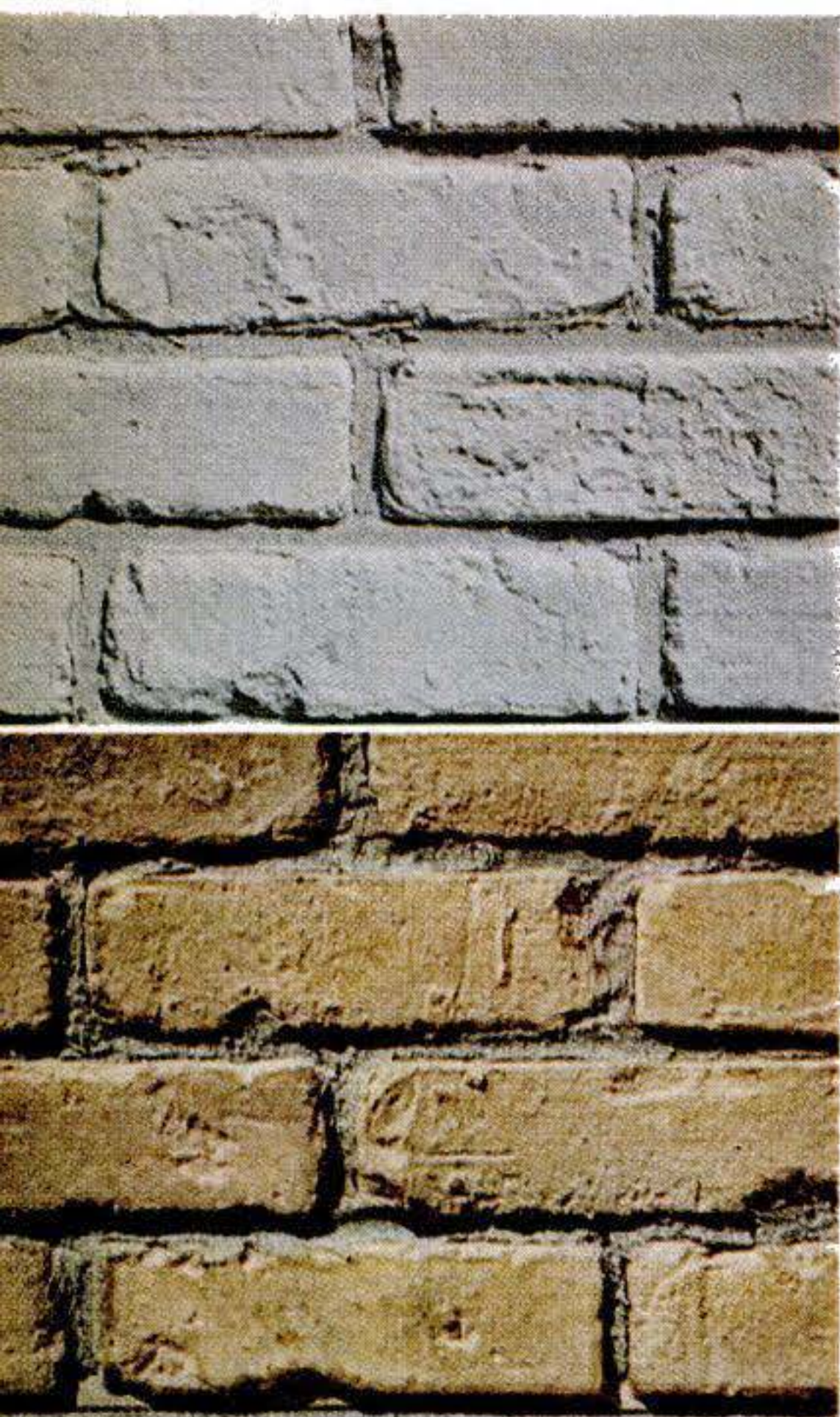


BEGINNING HERE: 20 PAGES OF HOME-IMPROVEMENT IDEAS

Every year it gets a little easier to improve your home. The reasons? New products and new techniques. This year our annual fall home-improvement section takes a look at advances in both areas. Products? We report on artificial stone and brick — lightweight products for heavyweight jobs. We show you the easy way to install rain gutters that will last a lifetime because they're plastic. And we take a look at a

pair of new tools that sand away finishing problems. Techniques? Two consulting editors talk about easy ways to refinish wood and to pave without concrete. On top of this we have new ideas — how to get extra living space out of your attic and your kitchen; how to get two rooms out of one; how to wire up a switch that lets you control lights and appliances from your armchair. — A. J. Hand

Artificial Stone and Brick: Better Than the Real Thing?



A few years ago I wouldn't have touched those plastic reproductions of stone and brick. If I had touched them they would have buckled under the pressure—like the plastic in a blister pack.

Today I *have to* touch the stuff—to see if it's real. And even then I can't tell for sure. Artificial stone/brick has come a long way. In a lot of ways it's better than the real thing. For example:

- You don't have to be a mason to install it. Some of it sticks in place with mastic, some of it goes up with nails. But all that tedious masonry work is out.

- It's so light there's no need to install extra footings or foundations for support.

- Most products are nonporous, so they won't absorb dirt or oil or grease. Cleaning is usually a soap-and-water affair.

- It's thin. You don't give up a lot of living space with artificial stone and brick.

- You can get the artificials in a variety of types you'd be hard-pressed to find in the real thing. Our

samples: Roxite's panel brick (at left) in white or buff, and (below) Dacor's individual stone in Sutton, Oxford, and Paxton. Other available styles include new and used red brick, fieldstone, cut marble, slate, sandstone, lava, and many more.

Where can you use the artificials? Just about anywhere you can use the real thing. Exceptions? You can't use one where it would be directly exposed to flame, or intense heat. And most artificials shouldn't be used on floors (Plastronics' Bricover floor brick is an exception). You can use most of them outside, too.

Putting it up. Some types go up a single brick or stone at a time. Others go up in panels. The panel types are usually easier, and of course faster, to install, but the single pieces sometimes have the edge in realism. In any case, installation is always simple. It's best to pick a product by what the end result will look like, not installation methods.

Where to get it? Turn the page for a list of representative manufacturers and addresses.—A. J. Hand





Wall of brick behind modern stove looks just as handsome as the one behind an open fireplace in colonial times.

The Modern Route to the Old Brick Kitchen

By STEVE GREEN

After I moved into my house, I was left with a small budget for re-decorating and a large distaste for the appearance of the kitchen. After all, to someone who is an aspiring gourmet cook, bland pale-blue wallpaper just isn't the ticket. The rich earthy look of real brick was what I wanted and, after some investigation, I found that it wasn't hard or expensive (about \$1.75 a square foot) to come by.

For my kitchen, I selected 1/4"-thick ceramic brick tiles that look and feel like real brick. They are available from a variety of sources (listed on the next page), and I purchased mine from Sears, where they are called Concord brick. The brick is applied with an adhesive that is a dead ringer for actual mortar, so

the finished installation is almost indistinguishable from a real old-fashioned brick wall.

The first step. Plan your project and determine necessary amounts of materials. The bricks can be laid out in several patterns; two are shown. The wall with vertical bricks at the bottom (photo, next page) will have a parallel vertical row at top.

Be sure you allow yourself some extra material because, in trimming the bricks to fit into a given area, you are likely to be left with some unusable pieces. Most stores will permit you to return unopened boxes, so it is better to have an extra box or two on hand in case you need it to finish up.

The next step is to assemble the necessary tools. Sears will lend you

an installation kit, which includes a nipper for trimming the brick and a cutter that will section the brick cleanly. (Most stores that sell tile, stone, and brick will lend or rent you tools.) You'll also need a trowel for applying the adhesive, a putty knife or two, a tape measure or ruler, and a couple of pieces of 3/8" wood dowel.

Before you start work, cover the floor with newspaper. The dust and chips that result from trimming the bricks are very abrasive and can easily scratch your floor.

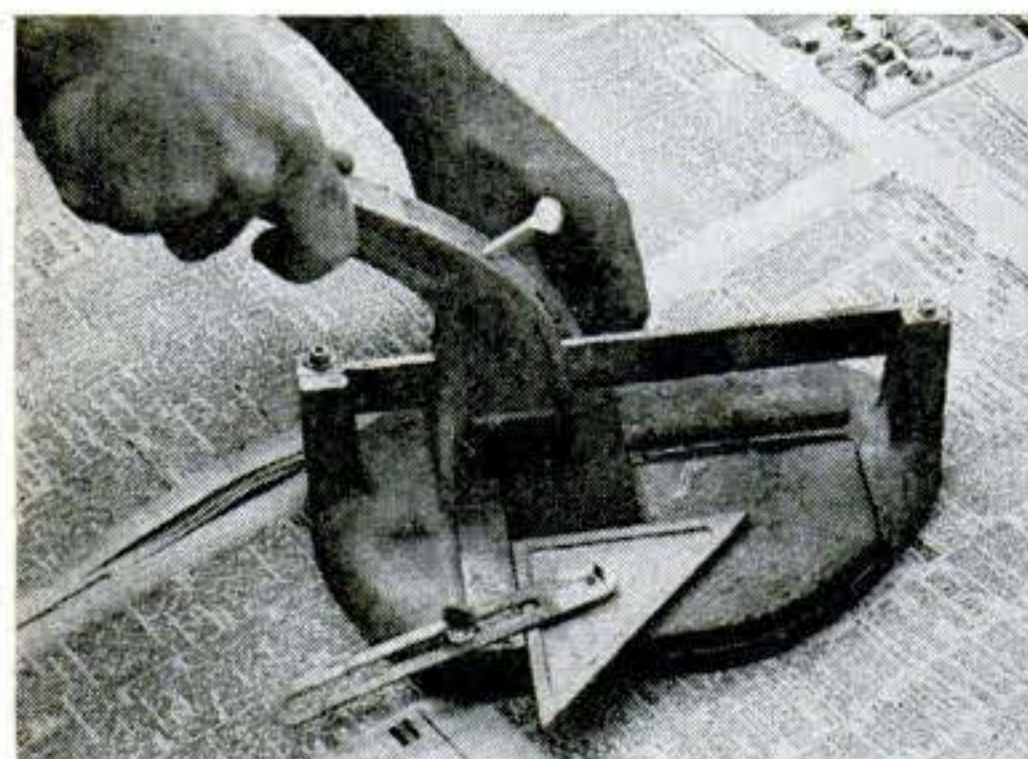
The rubber-base adhesive. It goes on the wall first. Take special care to cover the wall completely. Otherwise, the missed spots will show between the bricks. Work in an

Continued



Tools you need for installation: a trowel, putty knives, level, tape measure,

string, and tile cutter. Sears (and other sources) will lend cutter for the job.



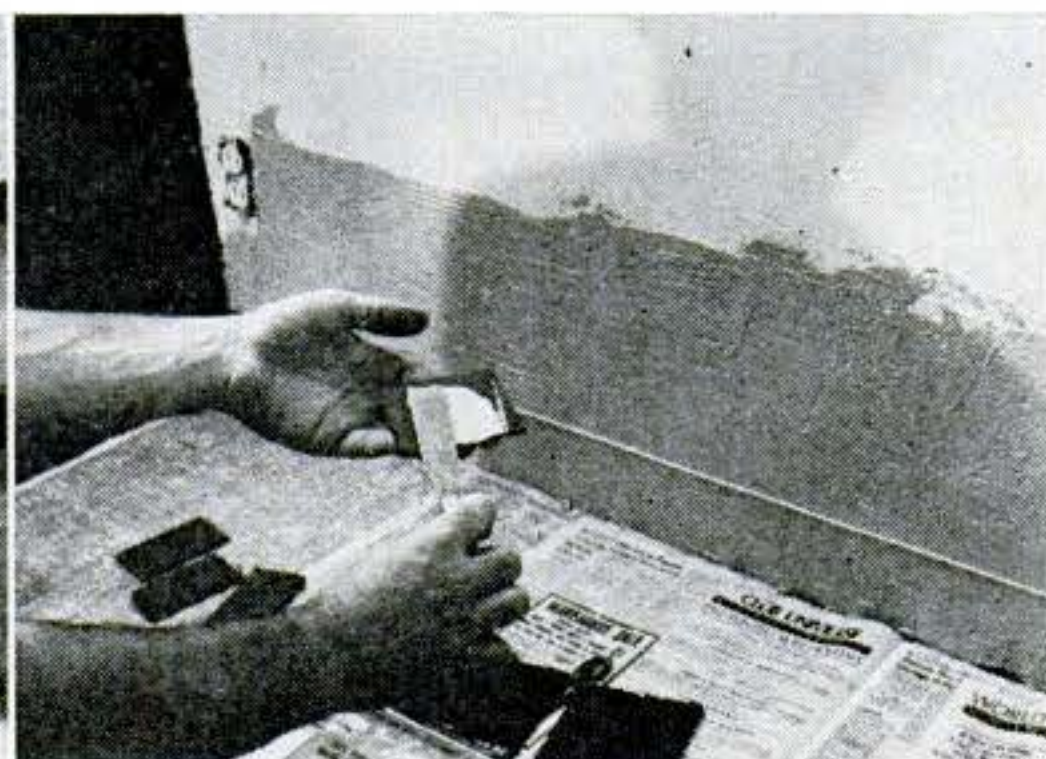
Cutting the ceramic bricks is a two-step operation, a lot like cutting glass. First you place the brick face down on the cutter, and score the back.



Break scored brick over a piece of dowel or other edge. Cover your floor with newspaper; chips and dust from the cutting operation are very abrasive.



Nippers will do the job for irregular or lengthwise cuts. Odd cuts are required for a good fit around moldings and cabinets. Sears lends you nippers, too.



Spread adhesive smoothly and evenly on wall only after you've measured and cut bricks to cover a section. Butter the back of each piece before placing it.



A 3/8" dowel makes a good gauge for even spacing of bricks. A row of vertical half-bricks at floor and ceiling compensates for building irregularities.



Check each row with a level after placement. If bricks are out of line you can move them before adhesive sets. A neat job calls for accurate placement.

area about six feet by three feet so the adhesive won't have time to set before you can apply the tiles.

Next, butter adhesive on the back of a tile. Spread it slightly thicker in the center than on the ends. Position and press the brick into place, using the 3/8" dowel as a guide. When you finish several bricks, use the level to be sure the row is straight. The instructions recommend the use of a taut string, but I found working with a level easier.

The cleanup. If you get adhesive on the tiles while putting them up, clean them with a damp cloth. When you finish work, the trowel can be cleaned with gasoline.

About the only unexpected part of the project was having to install a larger light fixture to compensate for the darker walls. I replaced an opal globe containing a 150-watt bulb with a twin 48" tubular fluorescent fixture. That does the trick.

The project took time and patience, but the warm feeling of pride when people comment on the beauty of the kitchen makes it all worth it. Besides, my scrambled eggs have acquired gourmet flavor. **P.S.**

The artificials: Who makes what, and where to write

Cavrok Corp., Industrial Park Ave., Vernon, Conn. 06066. Interior and exterior stone and brick.

Dacor Mfg. Co., Worcester, Mass. 01601. Interior and exterior brick and stone.

Eldorado Stone Corp., Box 125, Kirkland, Wash. 98033. Interior and exterior stone and brick.

GAF Corp., Building Prod. Div., 140 W. 51 St., New York, N.Y. 10020. Interior brick.

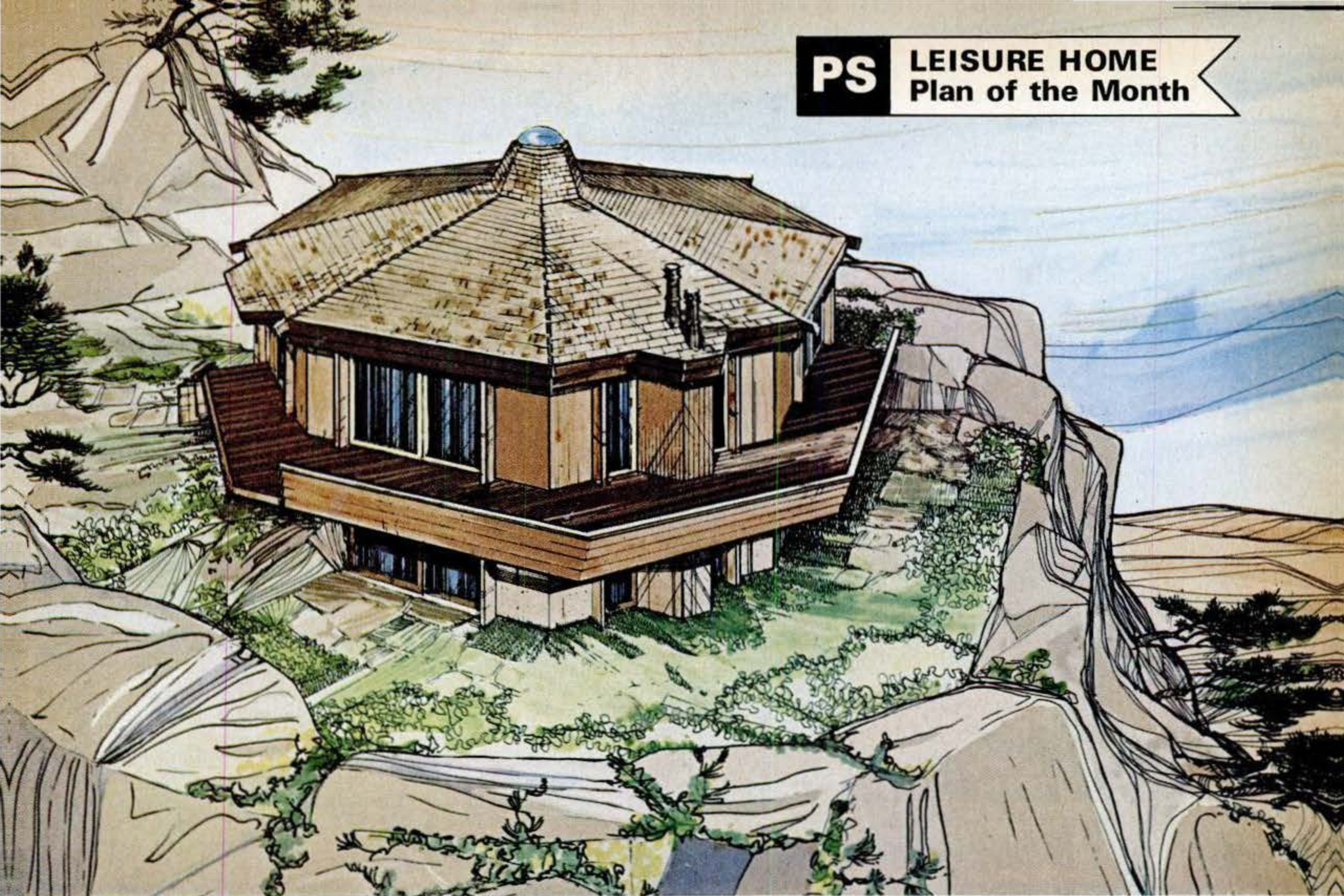
Meadowlite Corp. of America, 9950 N.W. 77th Ave., Hialeah Gardens, Fla. 33016. Interior and exterior stone and brick.

Plastronics, Inc., 586 Higgins-Crowell Rd., West Yarmouth, Mass. 02673. Interior and exterior brick and stone.

Roxite Div. of Masonite Corp. Bolen International, Inc., 7800 N. Milwaukee Ave., Niles, Ill. 60648. Interior and exterior stone and brick.

Sears (see Sears catalog). Interior and exterior stone and brick.

True Mfg. Co., 175 Winter St., Hanover, Mass. 02339. Interior and exterior stone and brick.



OCTAGON HOUSE

For Tight Perch or Level Site

Like a trimly cut gem, this multifaceted house makes the most of its setting—and its light. Seventh in our V-PAC Council series

The interiors of this house are as dramatic as the octagonal exterior. A central staircase (with skylight above) spirals down to the lower level. All ceilings—wood decking over exposed beams—taper up to the skylight. The open-plan living/dining space is further enhanced by sliding glass doors onto an elevated, cantilevered deck. The center zone

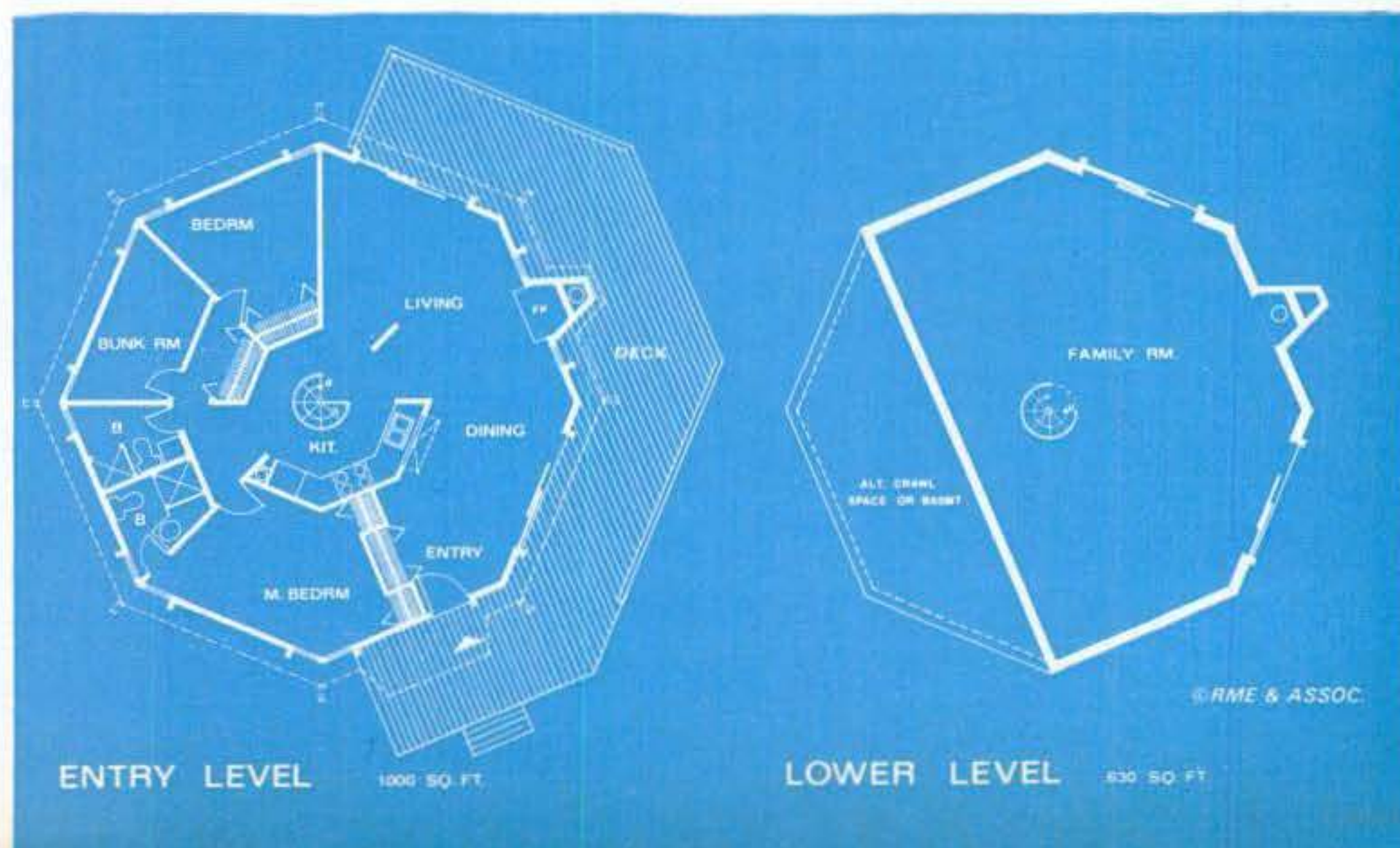
also contains an efficient kitchen, defined with a pass-through eating bar. Back-to-back bath areas serve three bedrooms.

Architect R. M. Engelbrecht calls

this house The Sekani—an Indian name meaning “those who live among the rocks.” But it can be built on a flat site, too—with the lower level (and stairway) optional. **PS**

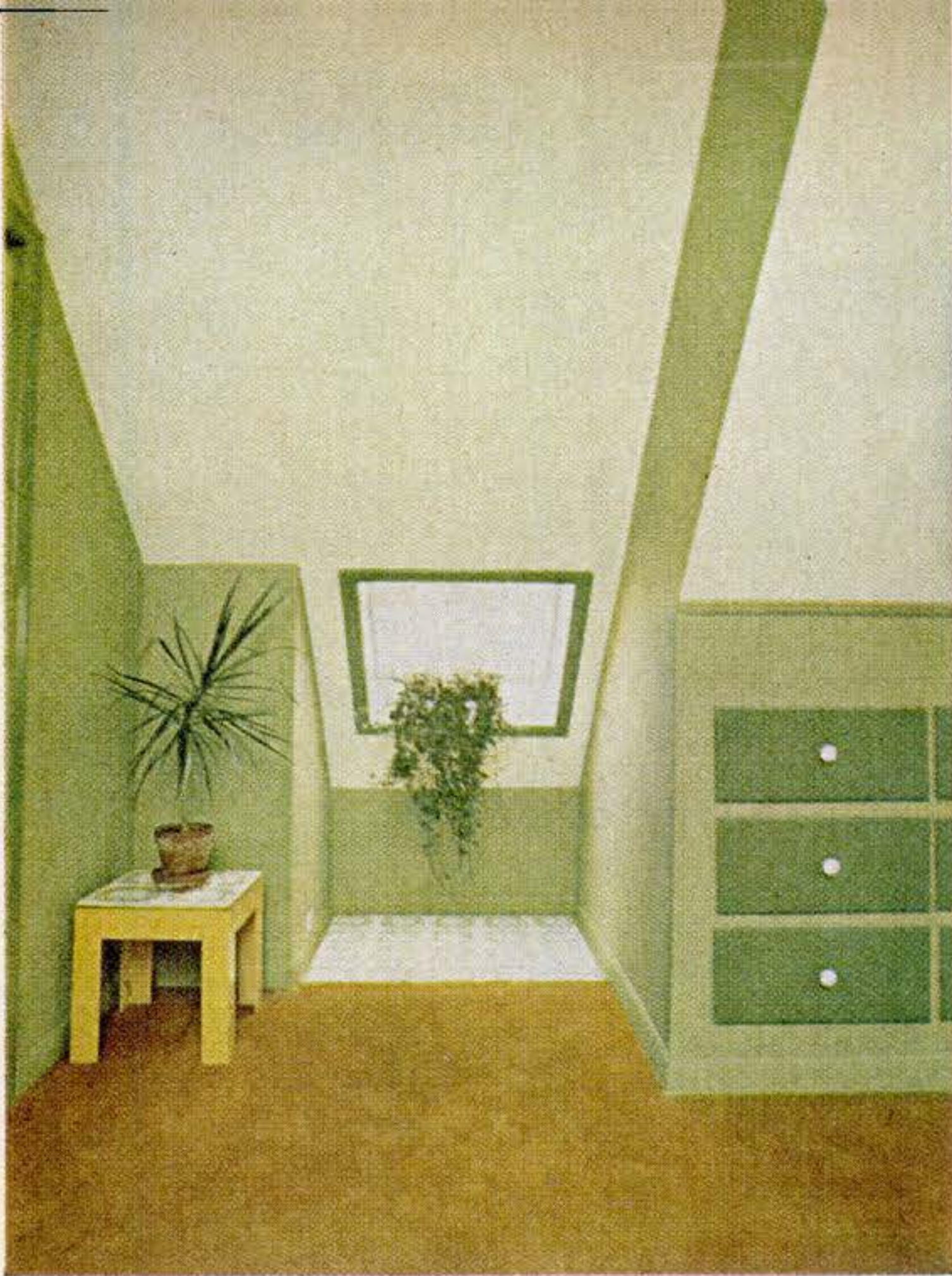
You can order plans several ways

The **Sekani study plan** (\$1) is a floor plan with additional specs to help you decide if house fits your needs and site. The **V-PAC Guide** (\$2) is newly revised to include earlier homes in series, plus additional plans. Set of blueprints: \$25; three sets \$35. Check or money order to **PS Vacation Plans Service, Box 622, Princeton, N.J. 08540.**





Put a



Skylight planter (left), sliding glass door to an outdoor deck (below), and knee-wall drawer storage highlight a bedroom built into the unfinished attic above. Though the room is small, the 18 built-in drawers eliminate need for bureaus. This keeps the room open, and makes the most of the available space. Two-tone green paint treatment combines with a glass door to bring outdoors inside.



Bedroom in Your Attic

It's the simplest and cheapest way to get the extra sleeping space you need

By A. J. HAND

Need extra sleeping space in your home? Put it in the attic. You'll save the bother and expense of extending foundations, walls, and roof—all of which is required when you expand by adding on. Attic conversions require little more than new flooring, wallboard or paneling, and a ceiling, plus heat and electrical hookups.

The only real problem in converting the average attic is that sloping roof overhead. It limits useful headroom at the sides of your new room. The usual solution is to put knee walls along the sides of your conversion. You use the center area—where there's lots of headroom—for living space, and you throw away the space behind the knee walls.

But why throw away that space behind the knee walls? There are many good ways to put it to use. I installed a total of 18 drawers in my knee walls, and eliminated the need for bureaus. This not only made the most of otherwise wasted space, but it opened up the best of the room by getting rid of the clutter of space-eating furniture. (More ideas for making the most of knee-wall space are shown on the next page.)

How to convert an attic. First step is to put in insulation if you don't already have it. Foil-faced fiberglass is usually the best bet. Put 6" between the rafters, and 4" in the walls.

Next comes flooring. I already had a tongue-and-groove subfloor in my attic, so I just nailed down particleboard underlayment on top of that, and carpeted wall to wall.

Continued

Fiberglass shower (from Universal/Rundle) for new bathroom—see next article—comes in through rough opening for glass door. It won't fit through ordinary doors. Far right: homemade combination track/guide that lets cutoff saw ride over bevel siding, cutting it away around door to make room for 1 1/4" pine trim.

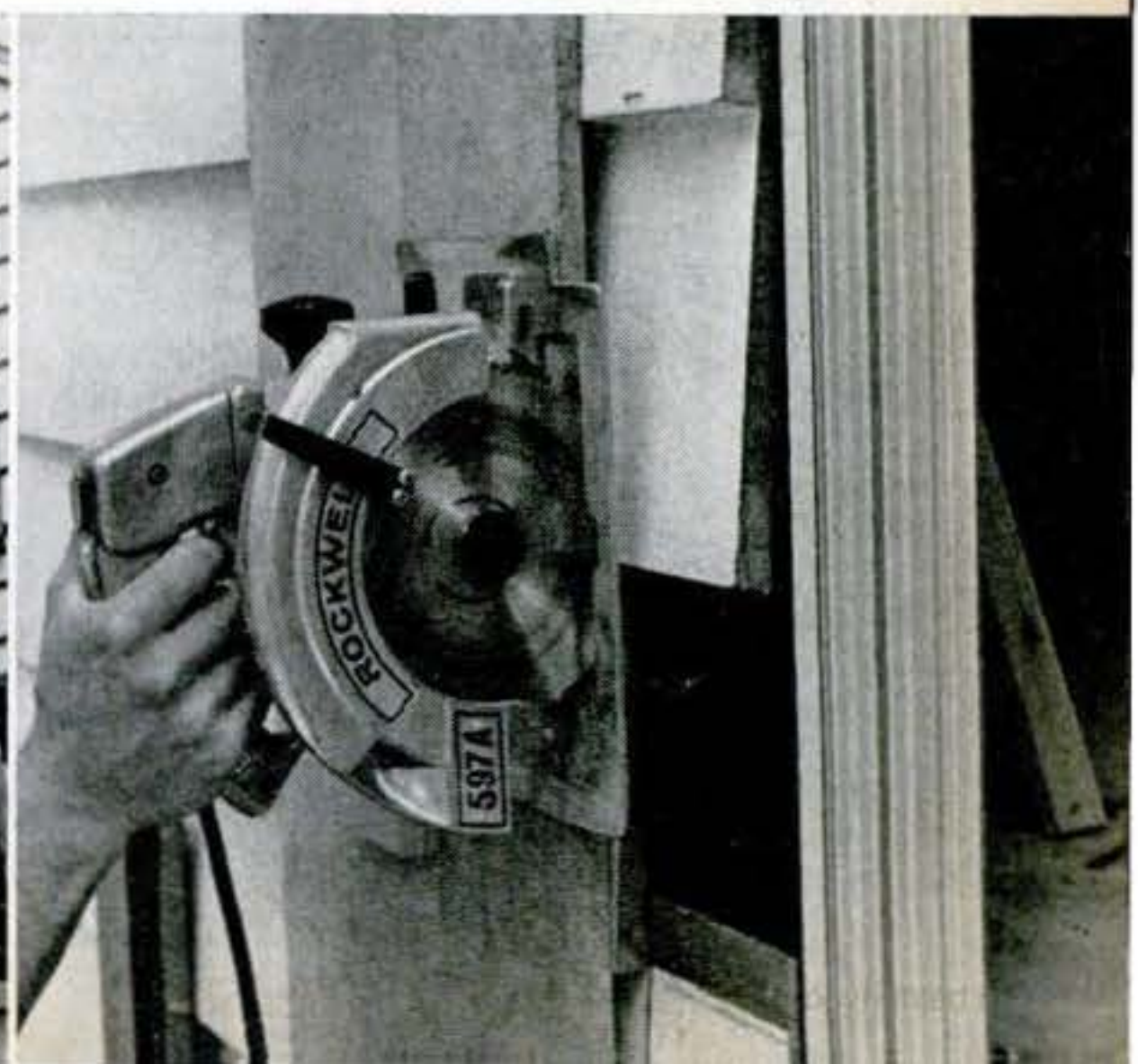


Knee-wall drawers put dead space to work. To make them, frame a 4' knee wall from rafters to floor. Use 2-by-4s. Cut triangular plywood or particleboard partitions and nail to knee-wall studs; fasten to flooring with cleats. Glue and

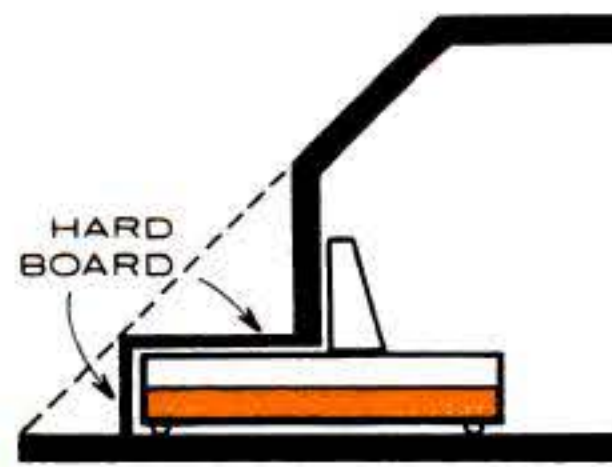
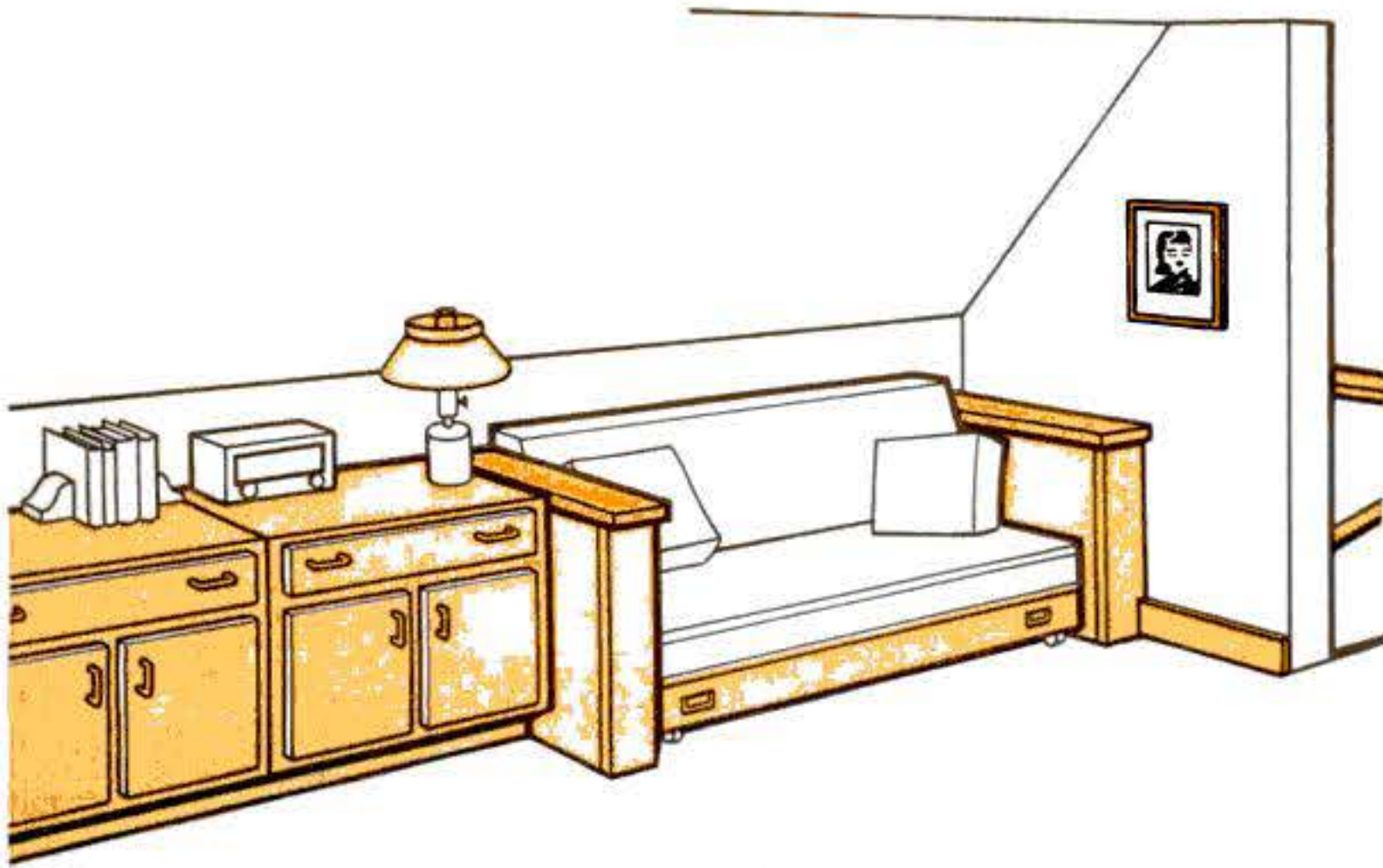
screw 1-by-1 cleats to partitions (for drawers to slide on), then cut paneling or wallboard to make the drawer openings. (Author used t&g pine.) Finally, make box-type drawers with oversize front panels. Finish and install.



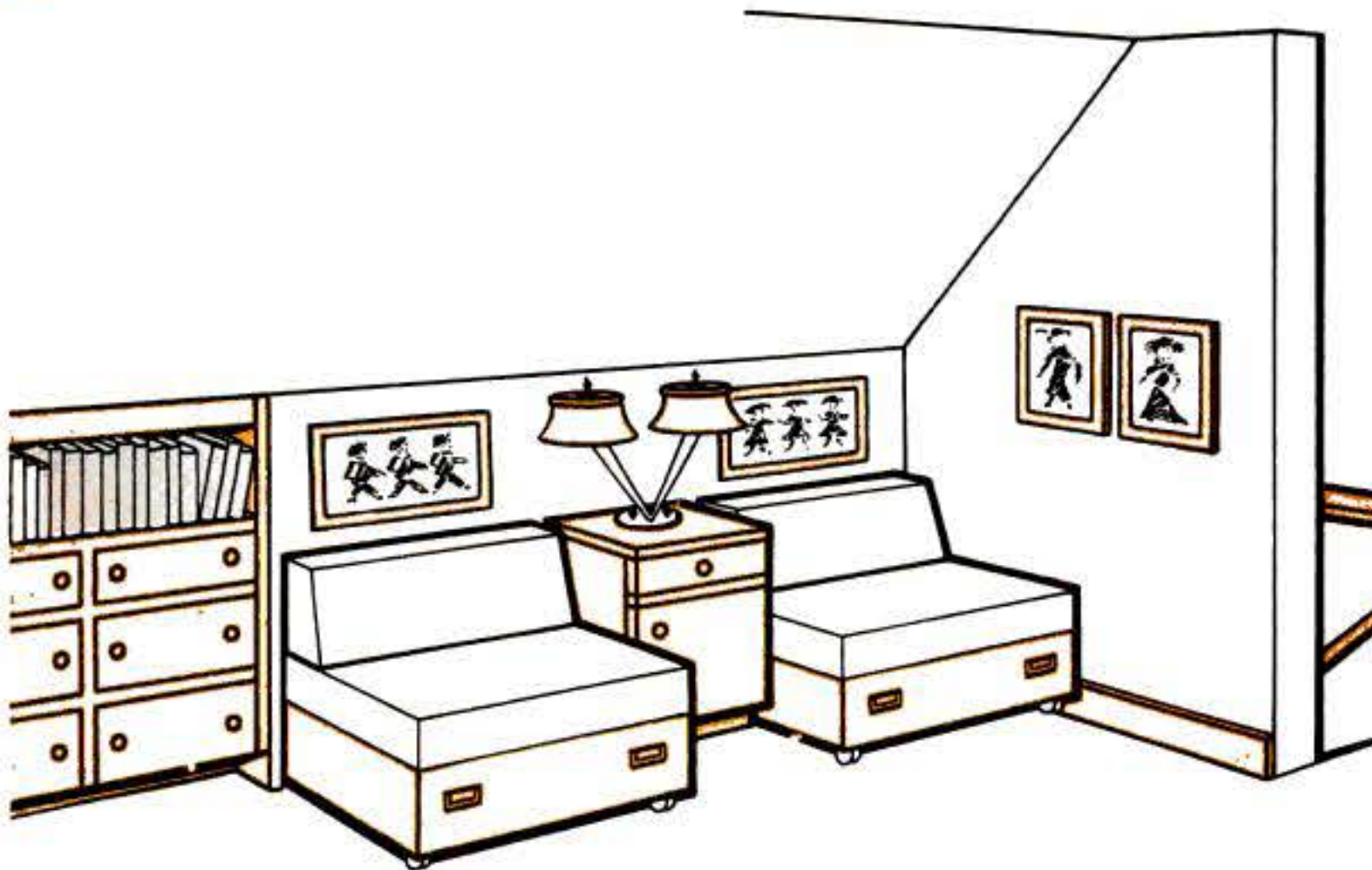
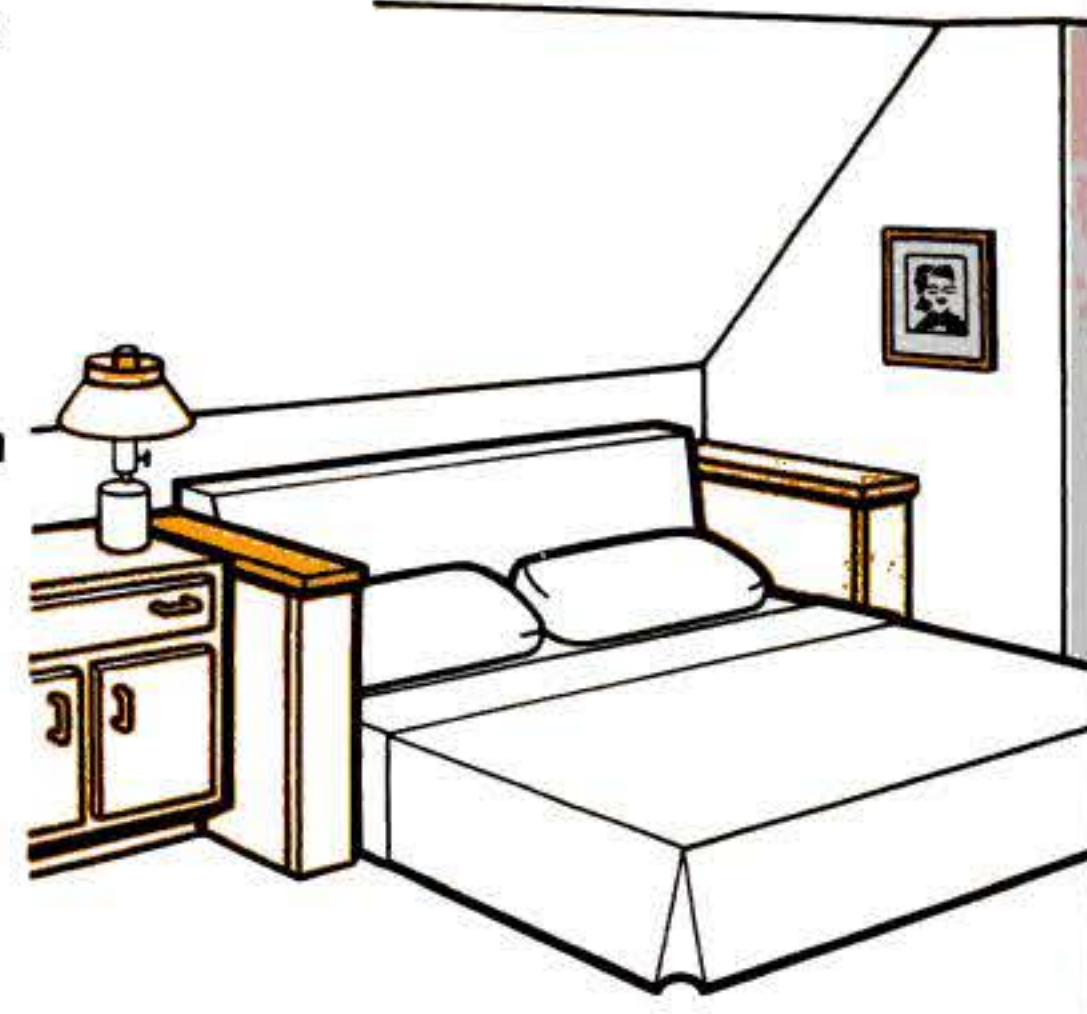
Ventilating-type skylight is easy to install. You can cut rough opening from inside, then remove plastic bubble from preflashed frame and install frame without even going out on the roof. Once frame's in place, replace the bubble. Inside, custom floor tiles provide a tough, waterproof surface for planting area. Tiles go down on particleboard underlayment with mastic, then are grouted.



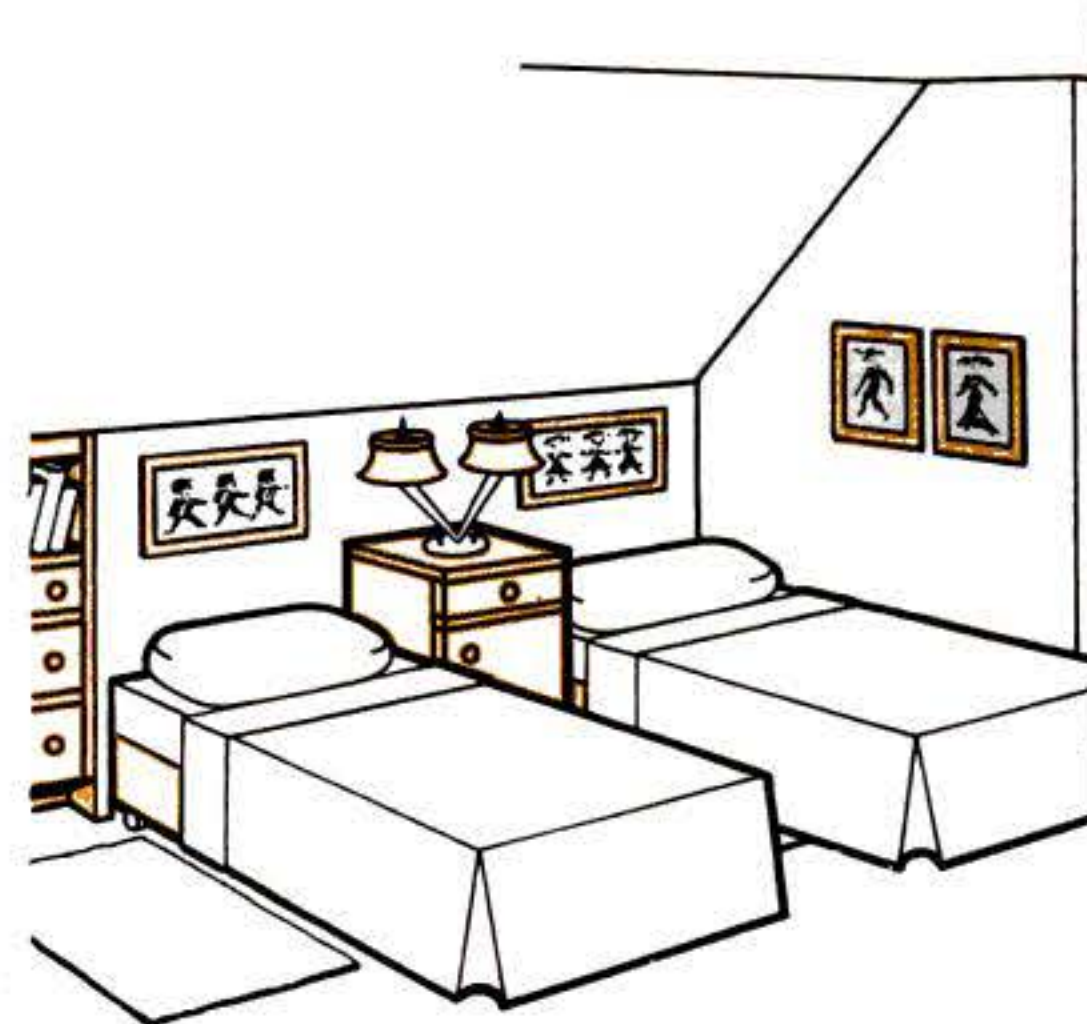
A few more ideas you can use to make the most of awkward attic space



A **convertible bed** is what you get if you use knee-wall space as seen in the top two sketches. Slide bed out of the wall and you have sleeping accommodations for guests, slide it back and it becomes a comfortable sofa in an upstairs den. Stock kitchen cabinets provide lots of storage.



Twin beds used the same way convert to oversize chairs (left and right). Recess ready-made chests of drawers into knee walls, use tops for recessed bookshelf. Make knee wall 4' high and you'll get maximum good out of 4'-by-8' sheets of plasterboard or paneling—whichever you choose for facing.



Stairway storage is another way to get more out of your attic. Above are two views of one idea. Put bookshelves in a stairwell wall, add extra storage on

back of wall—accessible from stairs—below shelving. Don't forget the space above the stairs (sketch above) and be sure you provide enough headroom (right).



If your attic joists are bare, cover them with plywood. The FHA requires at least $\frac{1}{2}$ " plywood over joists on 16" centers, which should be good enough if you plan to use strip-wood finish flooring. Nonstructural flooring like carpets or tiles will benefit from heavier plywood in the subfloor. Consider APA's Glued Floor System with $\frac{3}{4}$ " t&g underlayment [PS, May '72, p. 146].

Framing in. Once the subfloor is down, frame in the knee walls, putting them to whatever use you choose. Decide on your ceiling treat-

ment and frame it in. I nailed ceiling plasterboard right to the rafters—the simplest way to go—and I like the ceiling rising to a peak.

Other framing details you should add at this time include closets and doors. These jobs are greatly simplified if you use prehung doors. You just frame an opening to take them and nail them in place. I used double sliding doors for my closet, and a stock hollow-core flush door for the bedroom entry.

Now comes the electrical and heat hookup. You may want to call in a

pro to do this work. Electrical heat is no problem to install yourself, but hot air, hot water, or steam is too much for the novice to tackle.

Last the fun part. When you start nailing up plasterboard and paneling the work is near completion. From here on out you're finishing up—taping wall joints, painting, adding moldings and trim. Need more advice on how to do a job like this yourself? See the list of how-to-do-it books at the end of the article facing. They'll tell you all you need to know.



Tuck a Bathroom in a Dormer

My new attic bedroom shown in the preceding article deserved a new bathroom. But the bedroom job had just about used up all my free attic space, and my free time. My solutions may solve your problems, too.

First, to solve the space problem, I built a dormer by cutting out a section of roof, swinging it up, and building the dormer walls right under it (see sketch below). This trick saved the time and expense of building and shingling a whole new dormer roof.

Inside the dormer I saved time by using plastic. The entire waste system is plastic—even more widely accepted by local codes than plastic supply lines.

And for my shower, I chose a one-piece, fiberglass-reinforced plastic Unishower. This little timesaver took only about an hour to frame in place—a lot less time than building and tiling my own shower stall.

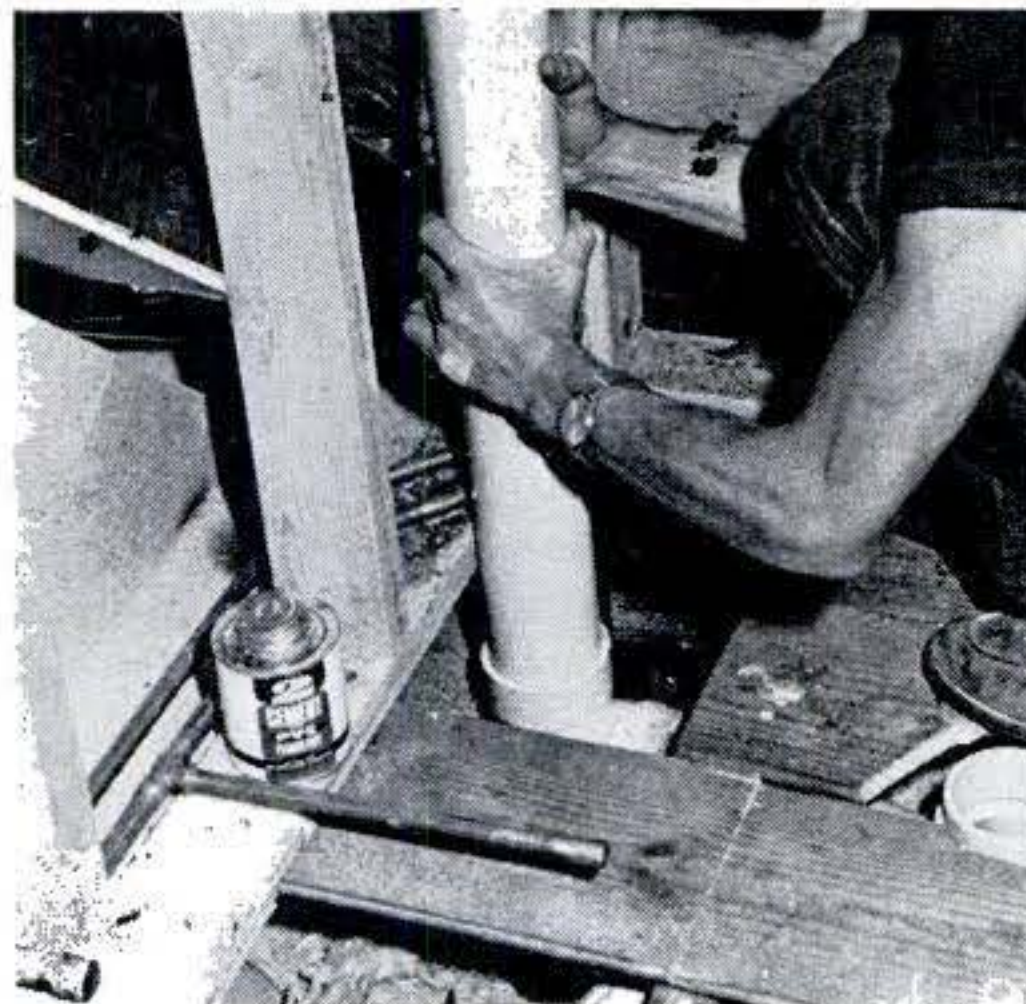
If you like the luxury of a tub, Universal-Rundle also has one-piece tub/showers that are equally easy to install. But neither the shower nor a tub will fit through a standard door. If you plan to use one, make sure you have a way of getting it into your home. I took mine in through the opening for the sliding door in my bedroom.

If you're building in a dormer, you've no problem. Bring the unit in after you raise the roof, but before you frame the walls.

If building your own bath or bedroom sounds like it's over your head, try these books: *The Practical Handbook of Electrical Repairs* and *The Practical Handbook of Plumbing and Heating*, both by PS Consulting Editor Richard Day (\$4.95 each; Fawcett, 1515 Bway, N.Y. 10036). *Modern Carpentry* by Willis H. Wagner (\$7.96; Goodheart-Wilcox Co., S. Holland, Ill.)—A. J. Hand



Dormer bath has plenty of room for shower, linen closet, toilet, and vanity. Vanity is a stock unit with slate Formica added to waterproof top, decorate panels.



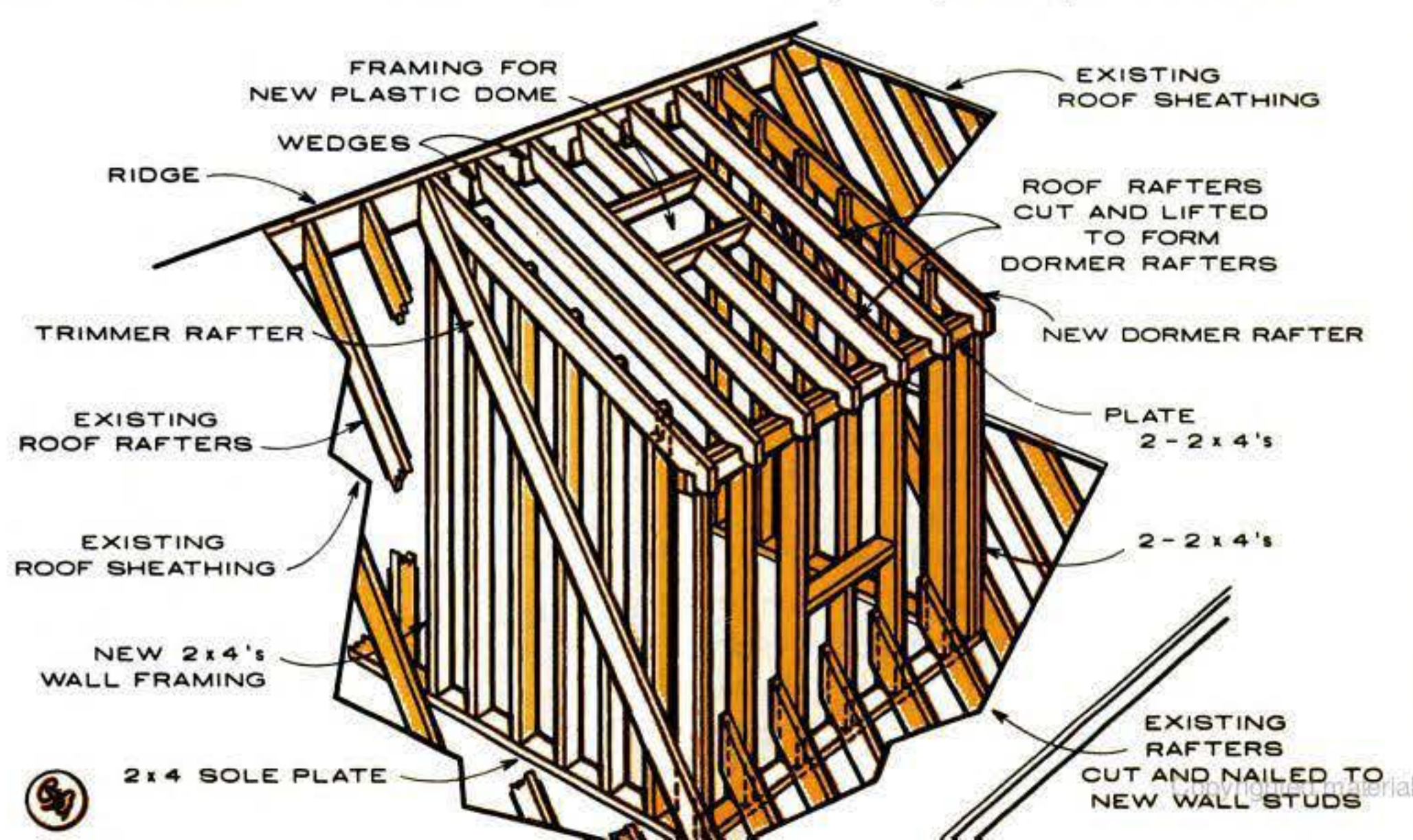
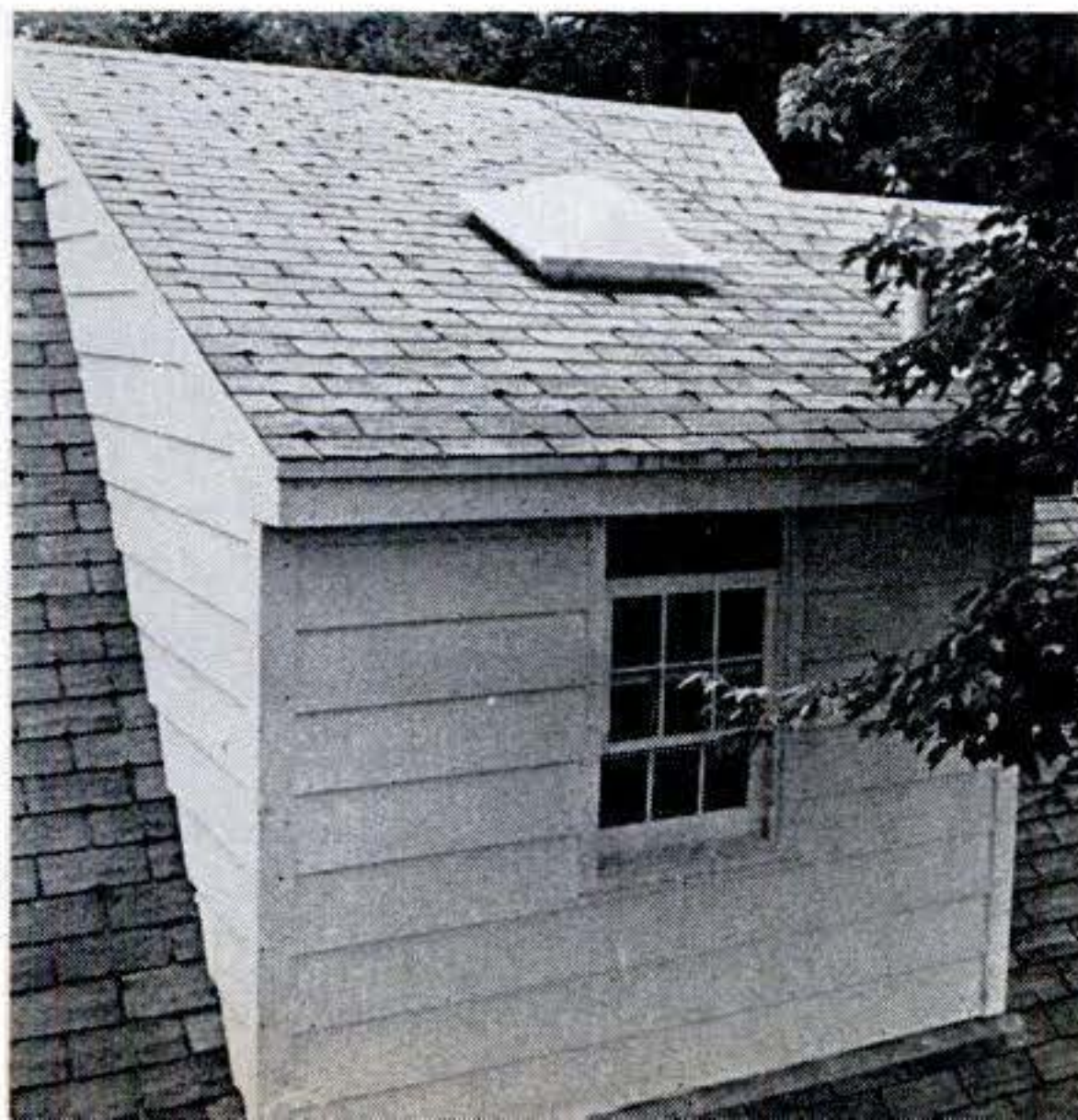
Plastic waste lines are easy to install. For details, write Sears, Philadelphia, Pa. 19132, for booklet #39A7479 "How to Install ABS Plastic Pipe."



One-piece shower from Universal-Rundle, New Castle, Pa., is also easy to put in. Just frame it in place and hook up to plumbing. Unit here is 36" Unishower.



Good tight seal even on roughly-textured slate countertop is no problem for U/R rimless lavatory. It sets in a bed of caulk, and you wipe away the excess.





One home-improvement material that's dirt cheap:

SOIL-CEMENT

For walks, driveway, patio or play-area paving—an easy alternative to concrete

By RICHARD DAY
Consulting Editor/Home & Shop

Most building products have gone sky-high in price. The one that's still dirt cheap is soil-cement. "Dirt-cement," as those familiar with it lovingly call the material, contains a little portland cement and a lot of good old terra firma.

Dirt is free, and portland cement costs about what it did years ago. Soil-cement sets up hard. Not so hard as concrete, but hard enough to stabilize the soil, making excellent paving at about a quarter the cost of ready-mixed concrete.

You can use soil-cement for paving a sidewalk, driveway, or garage floor. It makes a great patio surface or subbase. A splash guard under house eaves, a shallow drainage ditch, or a fine play area can be made with soil-cement. At the least, S/C gets you out of the mud without having to haul in sand and gravel. Besides that, S/C is mostly your own native soil, blending in rather than contrasting with adjacent earth.

The cost of soil-cement depends on how rich you have to make it. And that depends on how well your soil and cement react together. A sandy or gravelly soil can be stabilized with just a little cement.

Clayey soils and ones containing much organic matter need more cement to stabilize them. (Dark-colored topsoils and straight clay are



These six steps to a basketball practice court include a barrow mix for

not good for soil-cement stabilization.) The cement required to make soil-cement runs from a low of six percent of the mix (by volume) to over 16 percent.

Although soil-cement is not new, there's no information currently available on making it yourself at home. The only published data I found is intended for use with much more sophisticated construction methods than we homeowners could manage in the backyard.

But recently Franklin W. Vaughan came to our rescue. A retired engineer and long-time Portland Cement Assn. soil-cement man "Doc" Vaughan has adapted his engineered construction methods to home-built S/C with complete success, and has become America's leading authority on soil-cement. He's agreed to share that expertise with PS readers.

"Anyone can make soil-cement at home," says Doc, "if they go about it right." We proved him out.

Roads built of soil cement prove its durability



First soil-cement road (near Johnsonville, S.C.) was paved in 1935. A state highway today, it serves heavy traffic, yet after 37 years remains sound.



System is still used for road building, but equipment is more sophisticated, including a tank truck to add water continuously to high-speed rotary mixer.



setting the backboard post. Court at right measures 16'-by-17', and has a raised edge for leveling. Cost: \$22.

Here's how. Any soil-cement project is begun by removing all grass and bad-acting black and dark-gray topsoil in the area to be paved. Neglect this, and your soil-cement won't harden sufficiently.

Decide on the depth to be stabilized. A 5" mixing depth usually does it. For a driveway that will serve a light truck, better mix 6" deep. The same for pavement built in a severe freeze/thaw climate where frost-heave is hard on any

paving. Foot-traffic-only S/C can be made thinner, say 4" thick. So can a soil-cement subbase for a brick or tile patio.

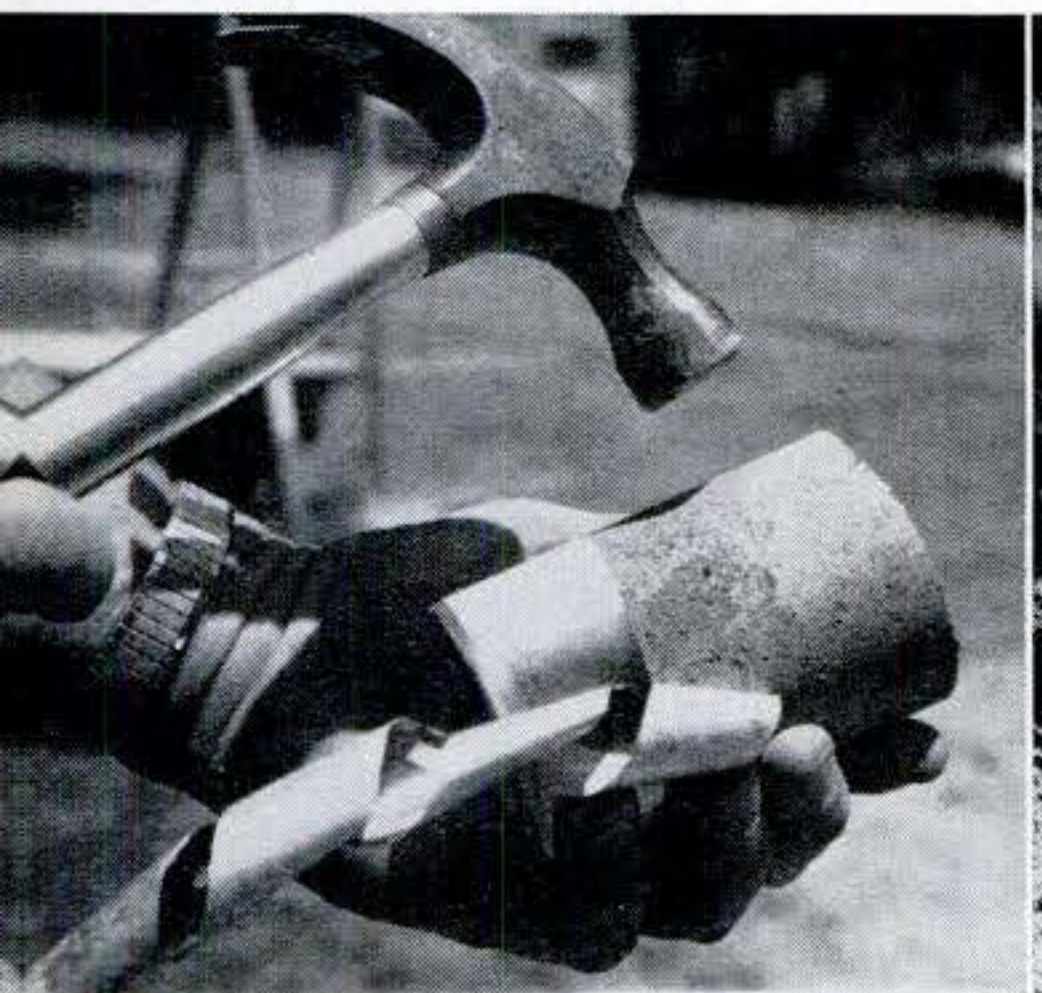
Next, decide on the percentage of cement to be used (see the table at end of article).

Check your soil. Try to avoid "heavy" or stiff clay-like soils, since these take a lot of cement and are tough to pulverize and mix. If possible, trade fill for a better-acting soil elsewhere in your yard.

Spread out the required amount of cement on top of the prepared ground. An easy way to gauge your cement spread is to mark off the area into grids of the size called for in the table. Choose their dimensions to fit into those of your project, keeping them as close to square as you reasonably can. For example, to get a 10-percent cement content in a 5"-deep pavement, according to the table you'd need one standard 94-lb.

[\[Continued on page 138\]](#)

Tests help you get a proper mix for your soil



For cheapest yet most effective mix for your soil, make samples with varying percentages of cement. A good mix hardens in a week, "rings" when struck.



Shovel test checks mix depth, uniformity. Dig scattered holes around tilled area and measure to point where color changes. Check sides for even-color blend.



Hand-squeeze test: When sample can be squeezed into a lump, then broken in two without crumbling, moisture content is right. Smooth with rake and board.



Two Rooms from One— with a Working

It's a privacy partition . . .
wardrobe . . . bookshelf . . .
closets for linen and storage

By LOUIS HOCHMAN
DRAWINGS BY CARL DE GROOTE

If you're making do with a less-than-ideal older home, you may have a problem similar to mine: rooms awkwardly joined by wide openings that may originally have had French doors—or a long, narrow room that could function better as two.

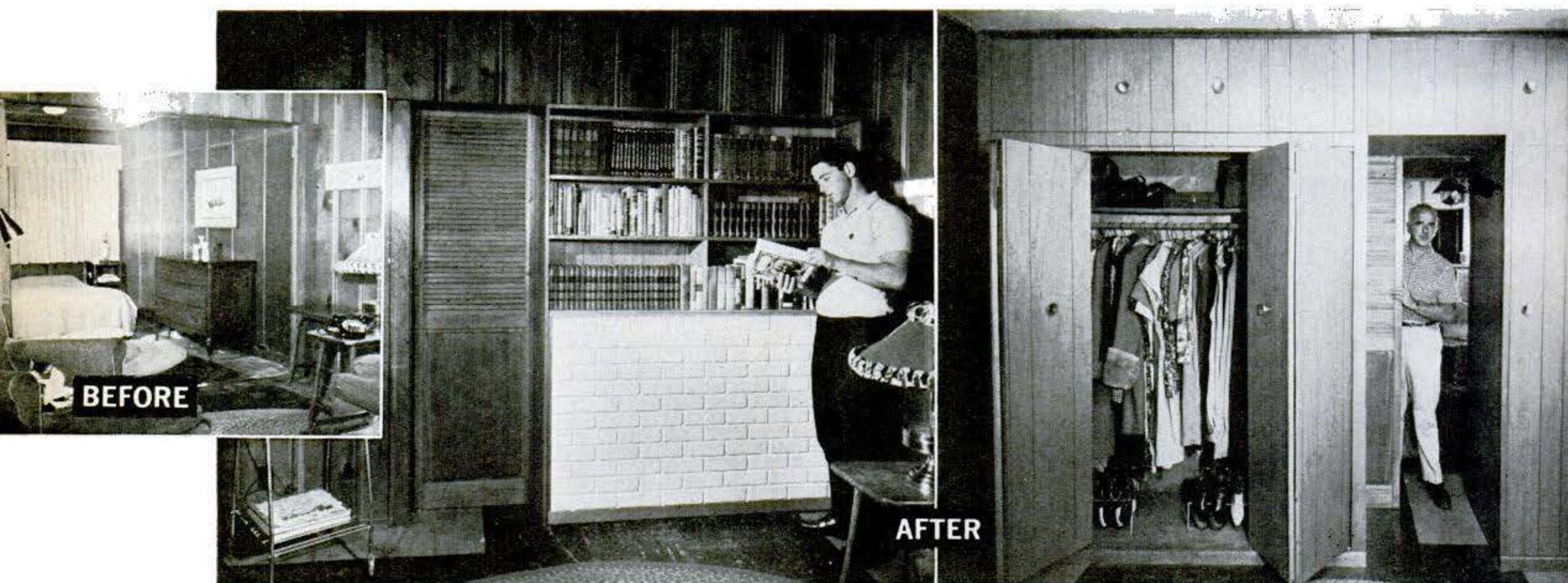
When I partitioned such a space in our home, I designed a two-faced functional wall that gave us handsome library shelves on one side and a bedroom wardrobe on the other.

As a bonus, I included several compartments for cumbersome items such as card and snack tables and projection screens.

The swing-down false front below the bookcase is faced with sheet brick [see article earlier in this section], but you could substitute any prefinished paneling of your choice. I built the entire case of $\frac{3}{4}$ " plywood, finishing off the exposed edges with veneer tape (1-by-10 lumber

could be used instead). The wardrobe assembly that stands back-to-back with the bookcase is framed of 2-by-2s (plus 1-by-2s) and covered with $\frac{1}{4}$ " panels; any prefinished wall paneling could be used for the exposed facing, with ordinary good-one-side $\frac{1}{4}$ " plywood for the back.

Bookcase backing. Note that this rear panel does double duty as the back of the bookcase, so you'll want to place the good side toward the shelves. Note also the back panel is doubled at one side to create a pocket for the sliding pass-through door. The latter hangs from a standard track, available from any build-



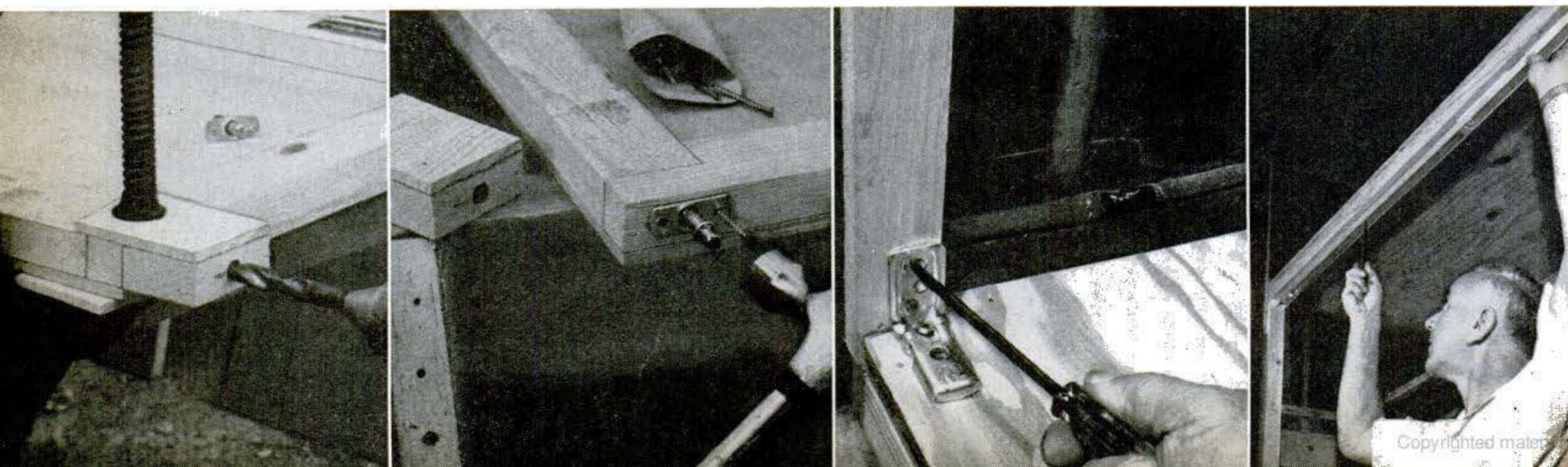
Big opening connected the study and bedroom in the old floorplan. New built-in is shown above from both sides.

Hardware for wardrobe eases installation of folding doors

Simple drilling jig, made from scrap and clamped to framed-panel doors, aligned with opposite sides, assures uniform location of holes for mounting hardware and keeps bit at right angles to edge

of door. After drilling, remove jig and attach pivot pin (second photo). Bracket for folding-door pivot is mounted to $\frac{3}{4}$ " plywood floor of wardrobe (third photo). Top channel for doors is screwed to bot-

tom edge of rail above wardrobe opening. Ceiling of wardrobe (also $\frac{3}{4}$ " plywood) extends across pass-through and linen closet (left photo, next page); compartment above it has its own folding doors.

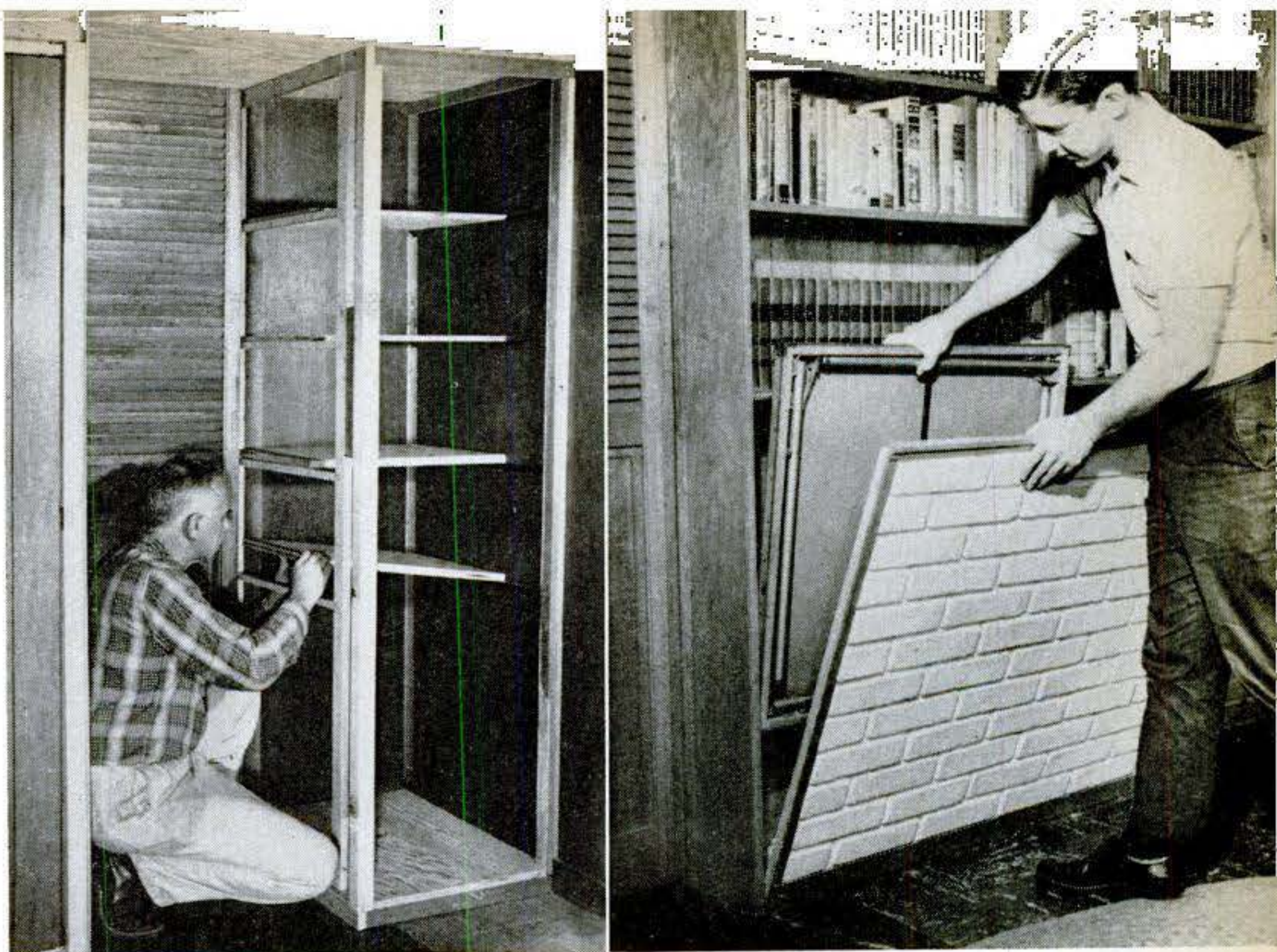


Wall

er's supply or home center, mounted at the back of the bookcase before framing the wardrobe. (See Section "X".) I used a sturdy L-shaped bracket of $\frac{3}{4}$ " lumber; if your bookcase goes all the way to the ceiling (instead of butting up beneath a door opening, like mine) you'd just build this bracket into the rear of the bookcase. I bought a louvered door (11 $\frac{1}{8}$ "-by-25"-by-80") for better air circulation.

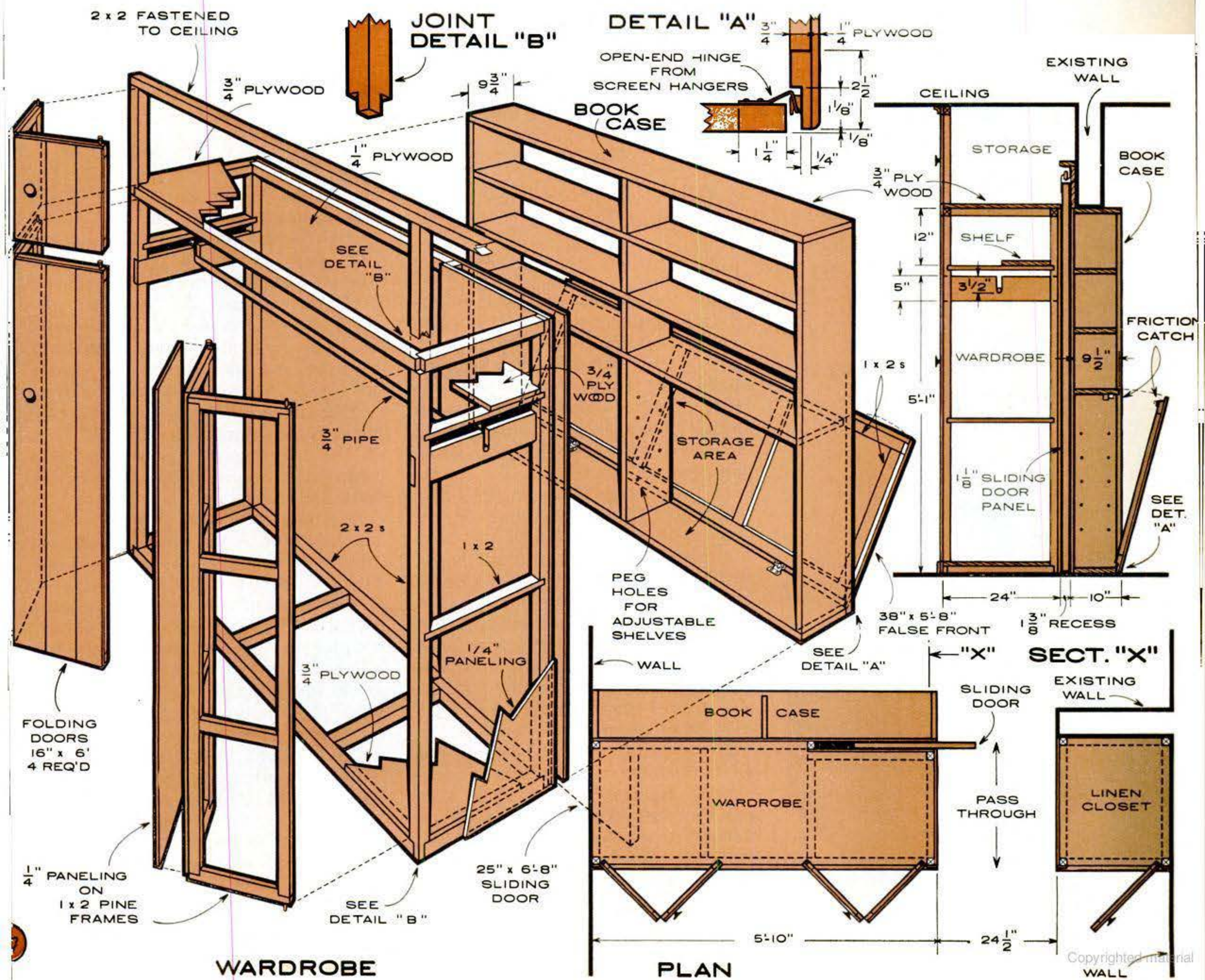
Space your bookshelves to match the various heights of your books. My middle shelf, for example, has a clear height of 10½" for conven-

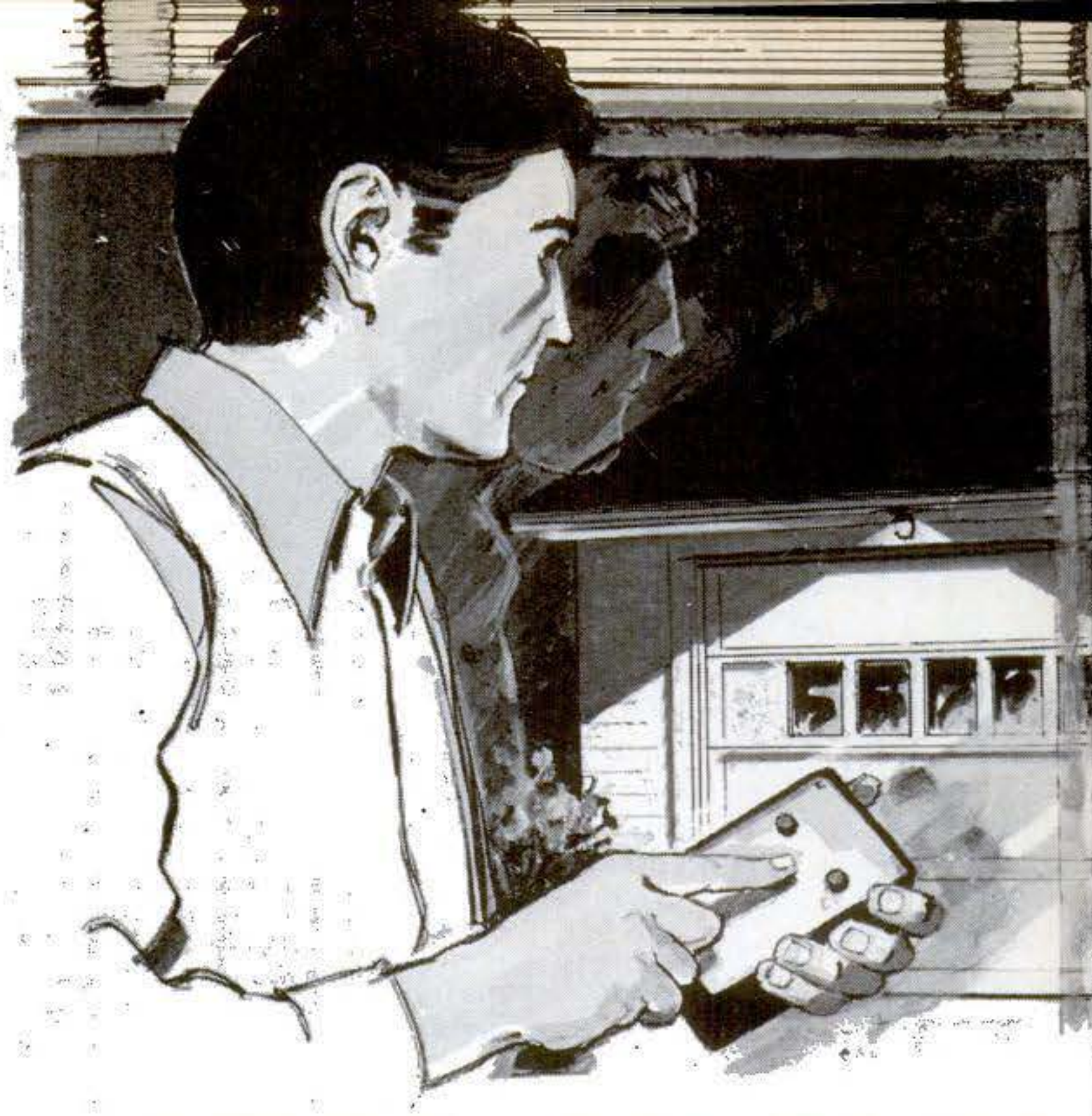
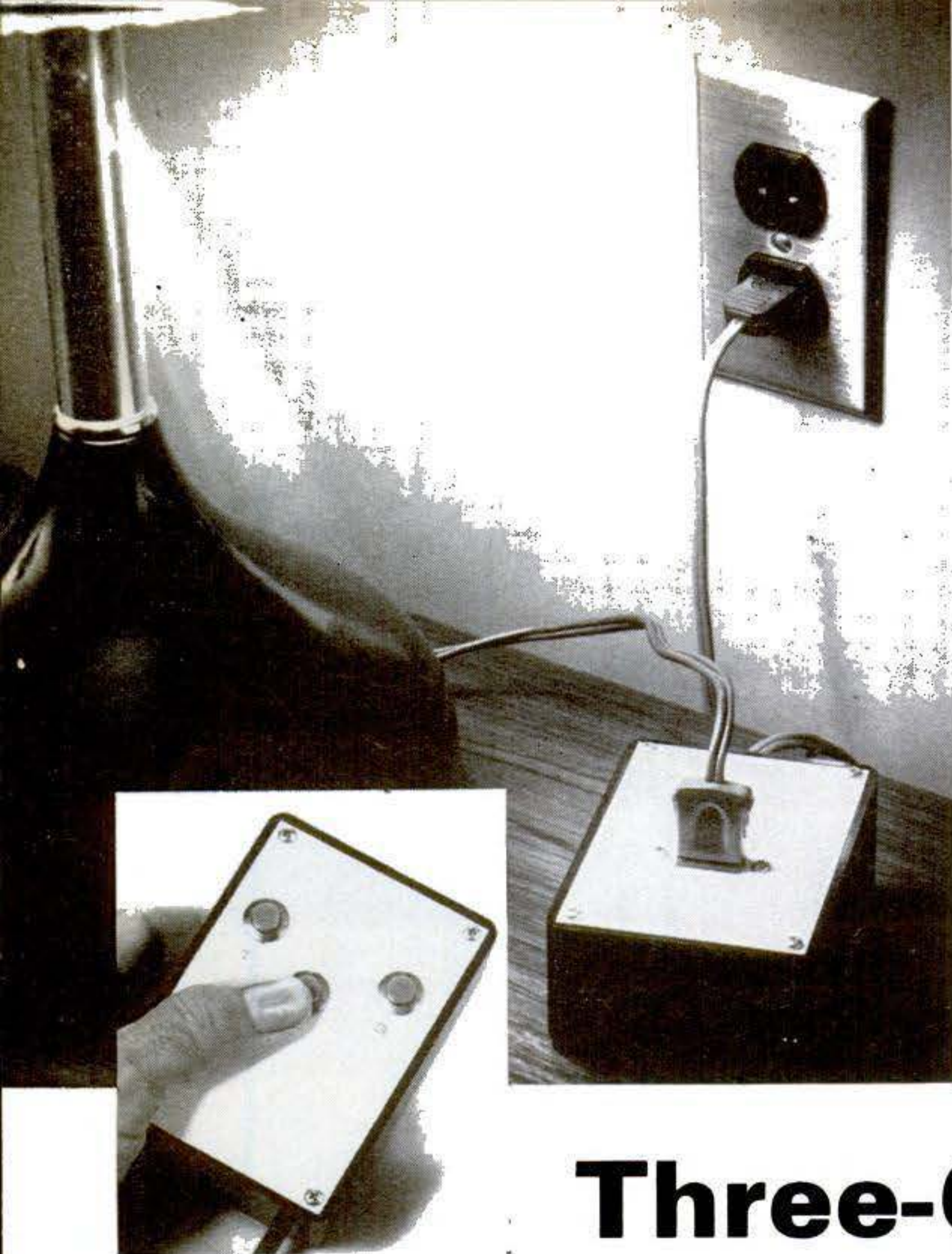
[Continued on page 134]



Both sides of wall have storage compartments for general household use.

Linen closet (left) has big plywood shelves. Card table stores in bookcase.



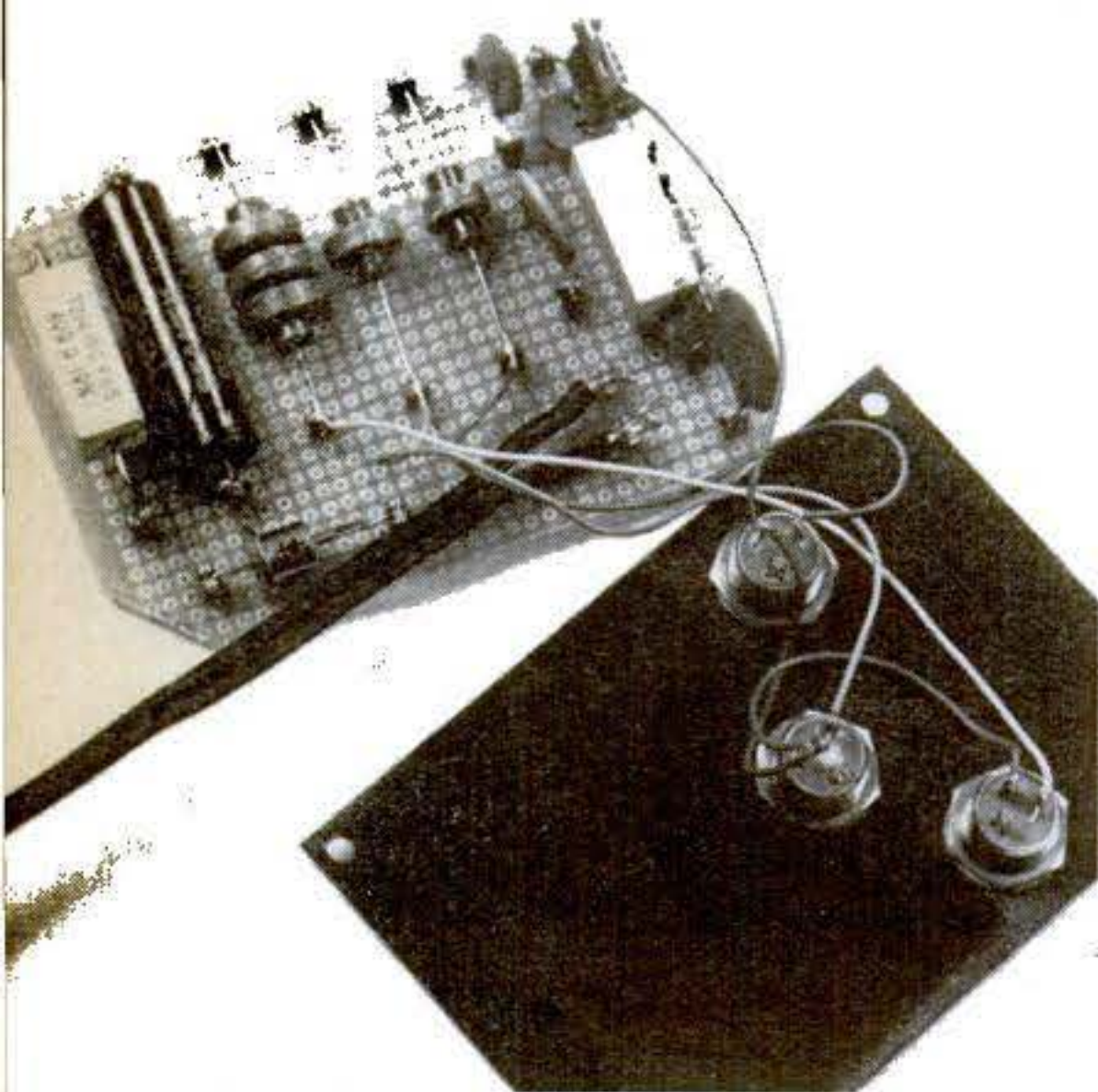


Wiring your garage light for on-off operation from the house is as easy as adding remote control to a table lamp (left): Just plug any light into a receiver and the receiver into a wall outlet. Existing house wiring makes connection.

Three-Channel Wireless



**Remote on/off control
without additional wiring
—just plug it in**



One-transistor transmitter supplies all three channels to receivers. Keep wiring short and neat to avoid possible shorts.

By **WILLIAM J. HAWKINS**
PS Electronics Editor

Turn the garage spotlight on and off from inside the house? Turn off a lamp from another room? Operate your outdoor lighting from your patio lounge? Tough jobs if you must run connecting cables through walls, around beams, and underground. Expensive, too. And, when you're done, you're "wired in" to a permanent installation with no flexibility.

Eliminate the wires, however, and you've eliminated most of the work, cut costs—and you own an on-off switch that goes with you. Control from the patio? Sure, but you also have on-off operation from any other part of your home. No new house wiring is needed—just plug the unit into the nearest AC outlet and you can control three appliances individually from one remote switch.

The wireless switch has four basic components: one three-channel wireless transmitter and three wireless receivers. You just plug the receivers into convenient AC outlets wherever they're needed.

The transmitter simply injects one of three tones—depending on the button pushed—into your existing house wiring. Each receiver, in-

dividually tuned to one of these tones, actuates when its tone is detected on the line, alternately turning your lamp, hi-fi, TV—whatever you've plugged into it—on and off.

Construction. As you can see from the pictorials, all components fit on a perforated board, and each receiver and the transmitter mount into a 1½"-by-3"-by-4" plastic box.

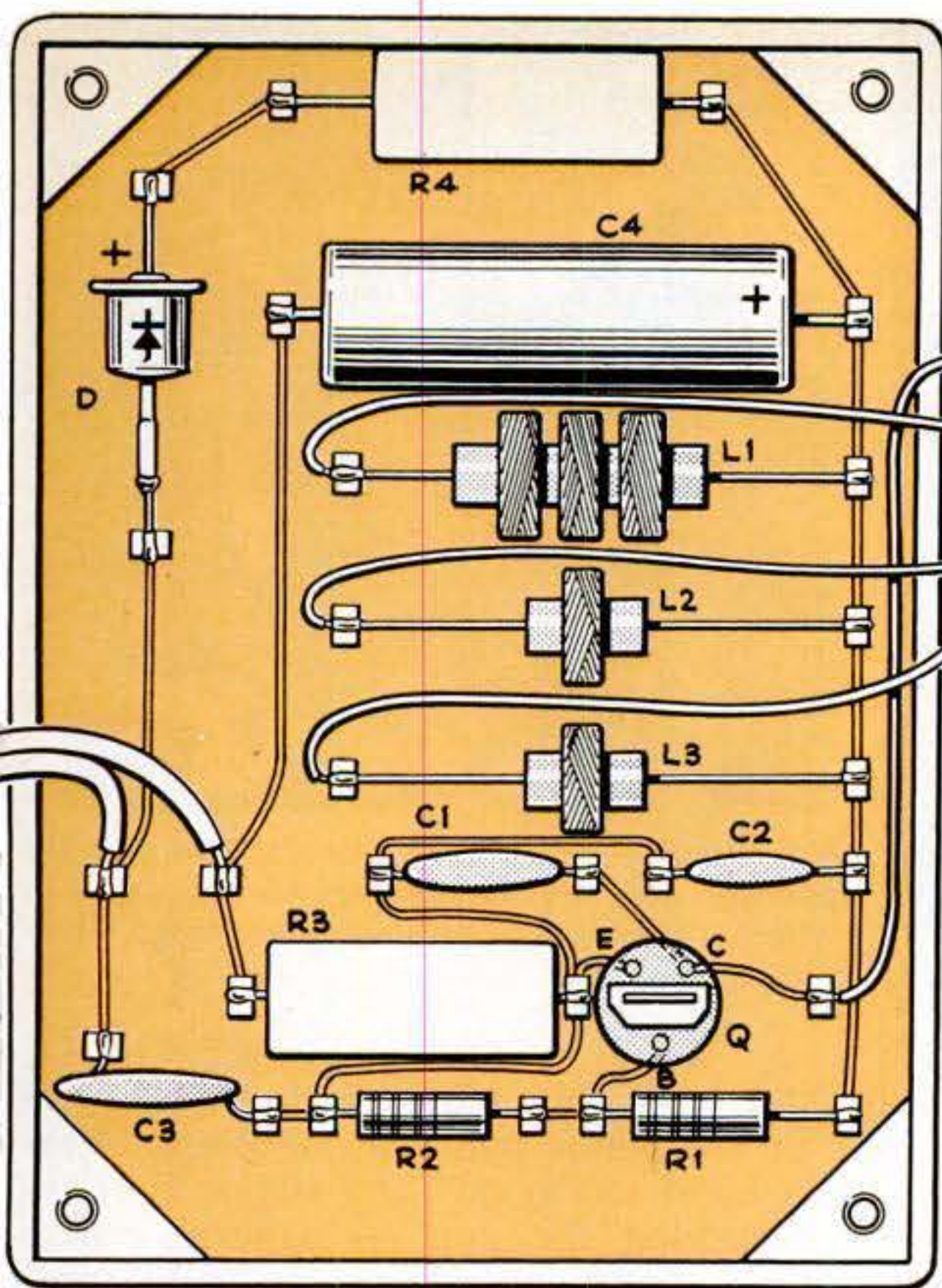
The neon bulb in the receiver must be positioned against the front of the photoresistor as shown. The neon light accomplishes two important functions in the receiver:

- Alone, it acts as a built-in tuning indicator. After you've constructed the receiver, simply tune the input coil to light the bulb.

- In conjunction with the photoresistor, the light acts as a photocoupler to actuate the relay. This cuts down the number of parts needed to operate the relay circuit. But since the photoresistor is sensitive to light, you must make sure it sees only the light from the neon bulb. This is easily done by making the box as light-tight as you can.

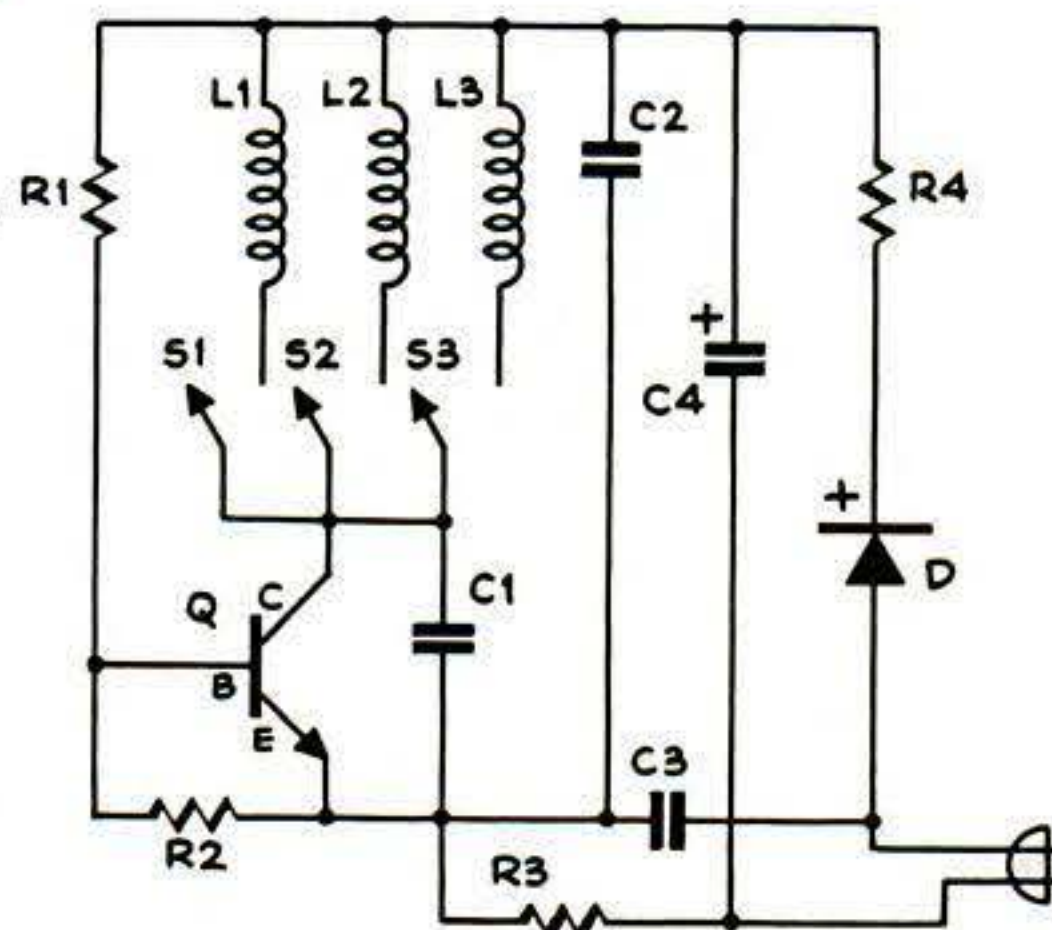
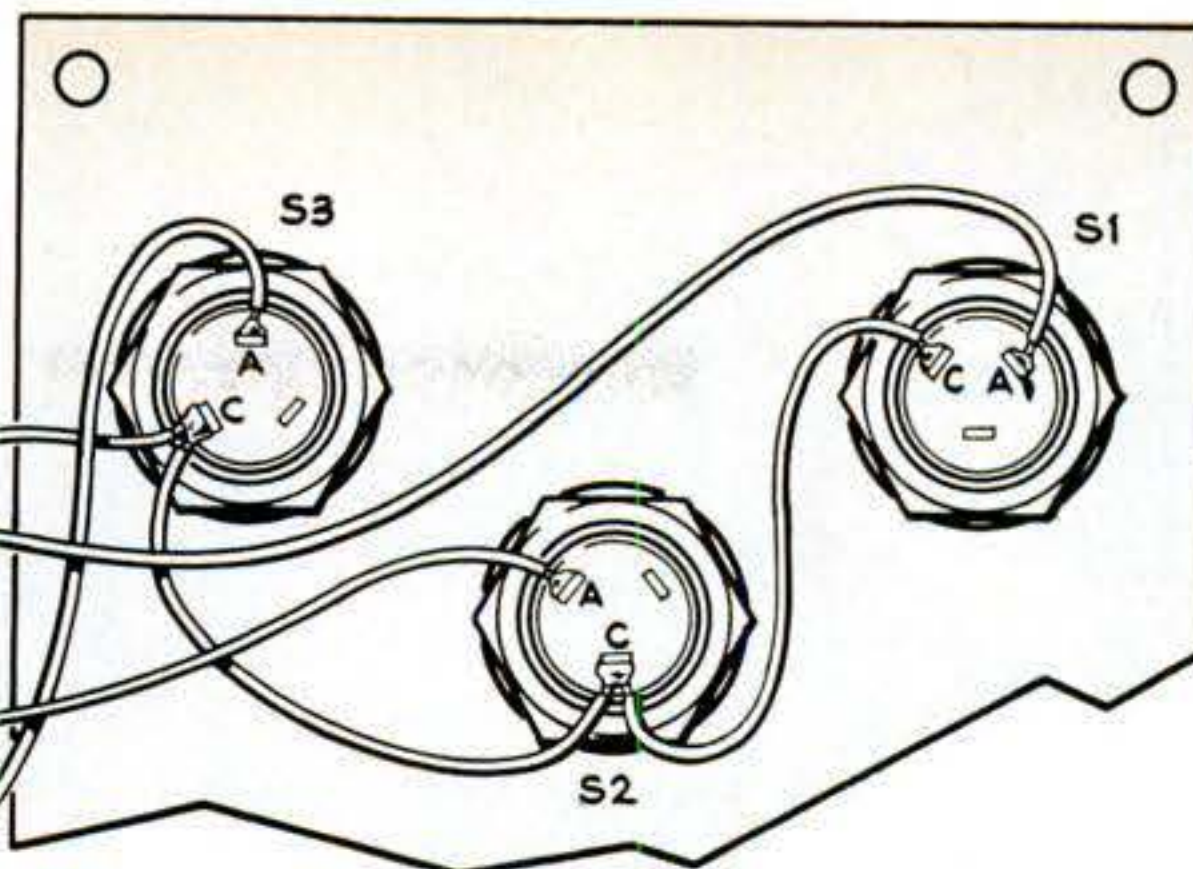
Although all components are standard we've made them available as a complete package, including hardware, through Williams Electronic Supply, 1863 Woodbridge Ave., Edison, N. J.

Prices are \$11.90 for transmitter



TRANSMITTER

C1, C2—0.02 mfd disc capacitor
 C3—0.05 mfd disc capacitor
 C4—20 mfd @150V electrolytic capacitor
 R1—12,000-ohm, 1/2w resistor
 R2—8,200-ohm, 1/2w resistor
 R3—750-ohm, 5w resistor
 R4—400-ohm, 5w resistor
 L1—750uh choke
 L2—420uh choke
 L3—200uh choke
 D—Diode 1N547 or eq.
 Q—Motorola HEP S3020 or eq.
 S1-S3—SPDT large pushbutton (N.C. not used)
 Misc.—Perf. bd., pins, trans. sock., line cord, box, cover



Switch—Use It Anywhere

and \$13.90 for receiver, postpaid.

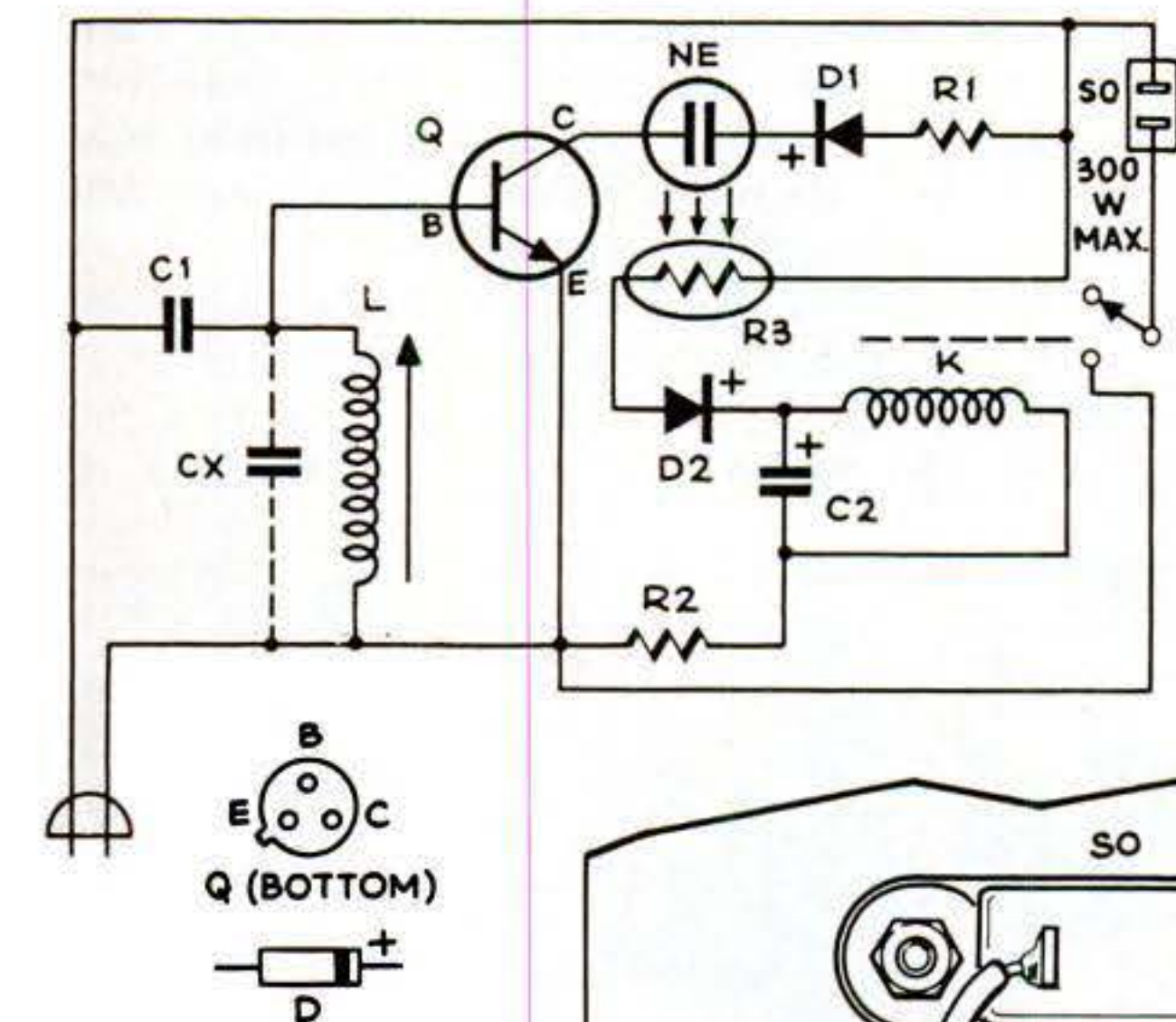
All the receivers are identical except for the capacitor Cx on the drawings. This capacitor, along with the slug-tuned coil L, determines whether it is receiver one,

two, or three. If you wish a particular receiver to actuate when you push number one on the transmitter, for example, use a 0.02 mfd capacitor for Cx. If you want it to respond to button number two, however, use

a 0.01 capacitor. Similarly, for number three use a 0.005 mfd capacitor.

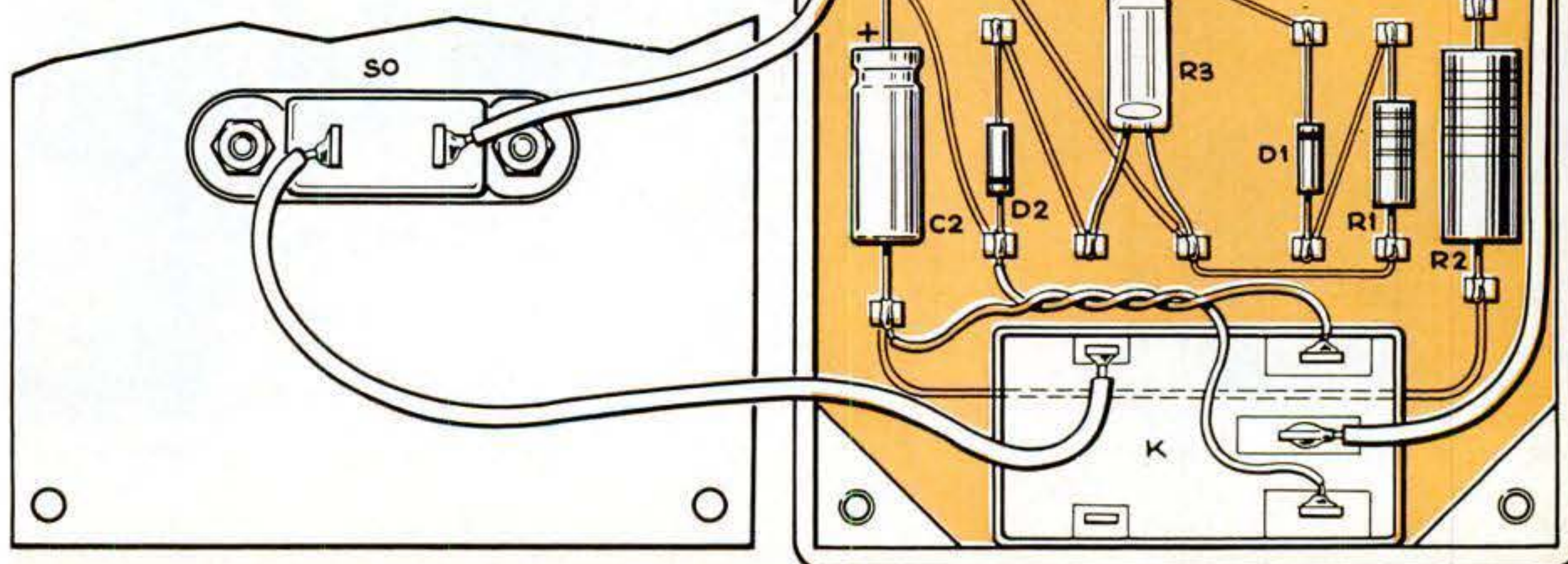
Tuning is simple. With both the transmitter and the receiver plugged into an AC outlet, intermittently

[\[Continued on page 121\]](#)



RECEIVER

C1—0.0025 mfd disc capacitor
 C2—20 mfd @ 16V electrolytic cap.
 Cx—See text
 R1—560-ohm, 1/2w resistor
 R2—1800-ohm, 2w resistor
 R3—Photoresistor (Clairex CL604L)
 L—508-816uh choke
 D1, D2—1N457 or eq.
 Q—2N3439 or eq.
 K—12VDC latching relay (Cornl. Dublr. 662-12)
 NE—Neon NE-2
 SO—AC socket
 Misc.—See above





Graco airless spray gun can paint this whole room in 30 minutes.



No tussle—the rental sprayer weighs 85 pounds, and the handle extends so you can wheel it around. Important: Be set to go when you're renting by the hour.

Big Pump That Speed-Paints Your House

By E. F. LINDSLEY

Fast? Just picture 2500 psi pushing out a half-gallon of paint a minute

Airless spray painting will let you lay on nearly half a gallon per minute of almost any paint or surface coating you can name. There's almost no fog or fuss, and no big compressor such as you'd need for air spray.

You can rent an airless paint rig for about \$30 a day. The rental agency, True-Value Hardware, takes care of post-painting cleanup and delivers a rig ready to go. You also get a short course in airless painting.

You'll have to learn some new rules. Rule number one: Never, but *never*, put your finger or hand over the discharge nozzle. And never point the gun at your face or eyes. In fact, the Graco spray gun has a safety lock on the trigger to prevent accidents. There's no kidding about the 2000 to 3000 psi that drive the paint out through a .021" hole in the carbide nozzle. It could inject paint right into your finger.

And you'd better have your hand moving when you pull the trigger or you'll pile paint in one place. After I learned to start hand movement and trigger pull together, I tried sweeping the gun on a level course over a path about 8' wide. In a series of half-lapped passes, I covered an 8'-by-8' wall in 30 seconds!

After the basic preparations, you should be able to cover a normal house wall and overhangs in a few hours. For a basement, with the pump unit sitting in the middle of the floor, 30 minutes or less should do it.

Airless spraying is not intended for fine automotive finishes, although there's no problem in handling any finish. Here are the clear advantages: eight to 12 times faster than a brush; heavier coating; great for rough masonry or shingles; little fogging, even inside; pump doesn't need overnight cleaning.

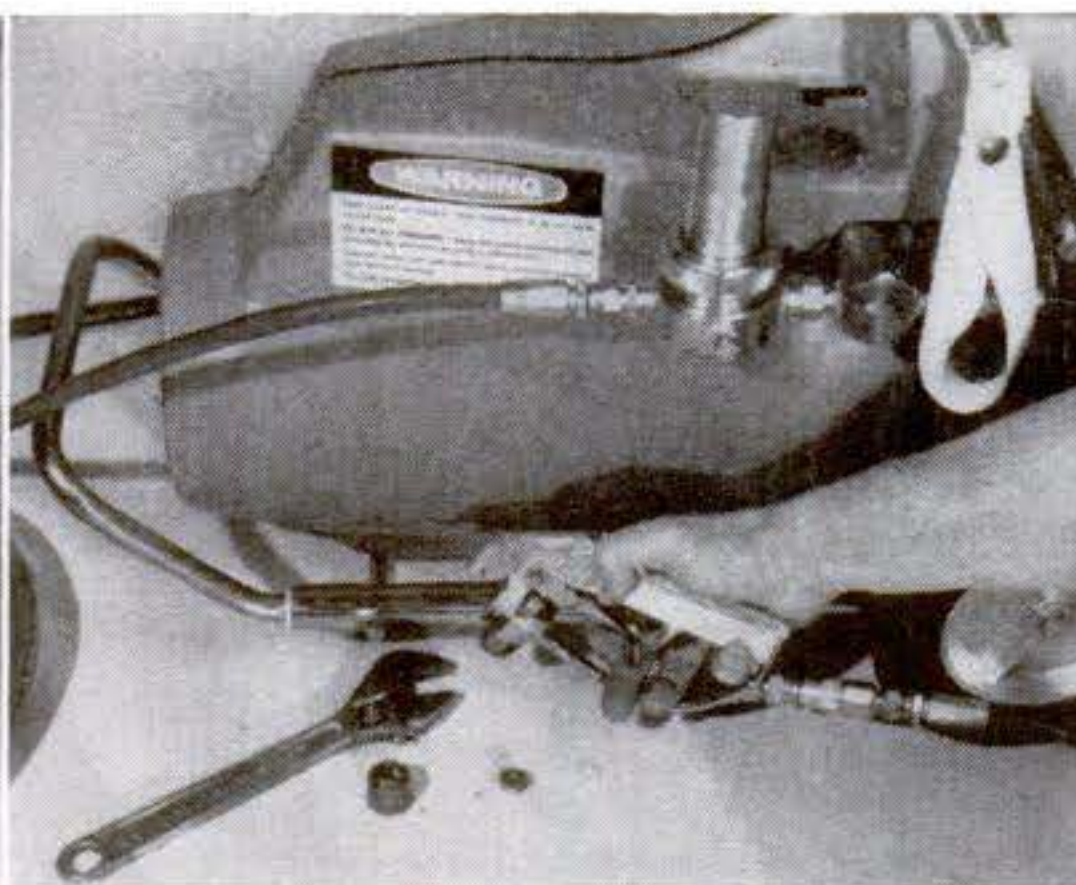
Disadvantages? Everything must be ready before you start; the high-pressure hazard is real, but not risky; masking and protection around windows and hardware take time, require touchup later.

Basically, the unit offers a 3/4-hp motor that drives through reduction gears to operate a crank and piston within a cylinder. When you start painting, you throw a pickup hose and strainer into the paint-supply bucket. The pump shoves the paint through a pressure regulator (normally set for 2500 psi), and if the set pressure is exceeded, the motor cuts off. Thus, when you release the trigger, the motor stops immediately.

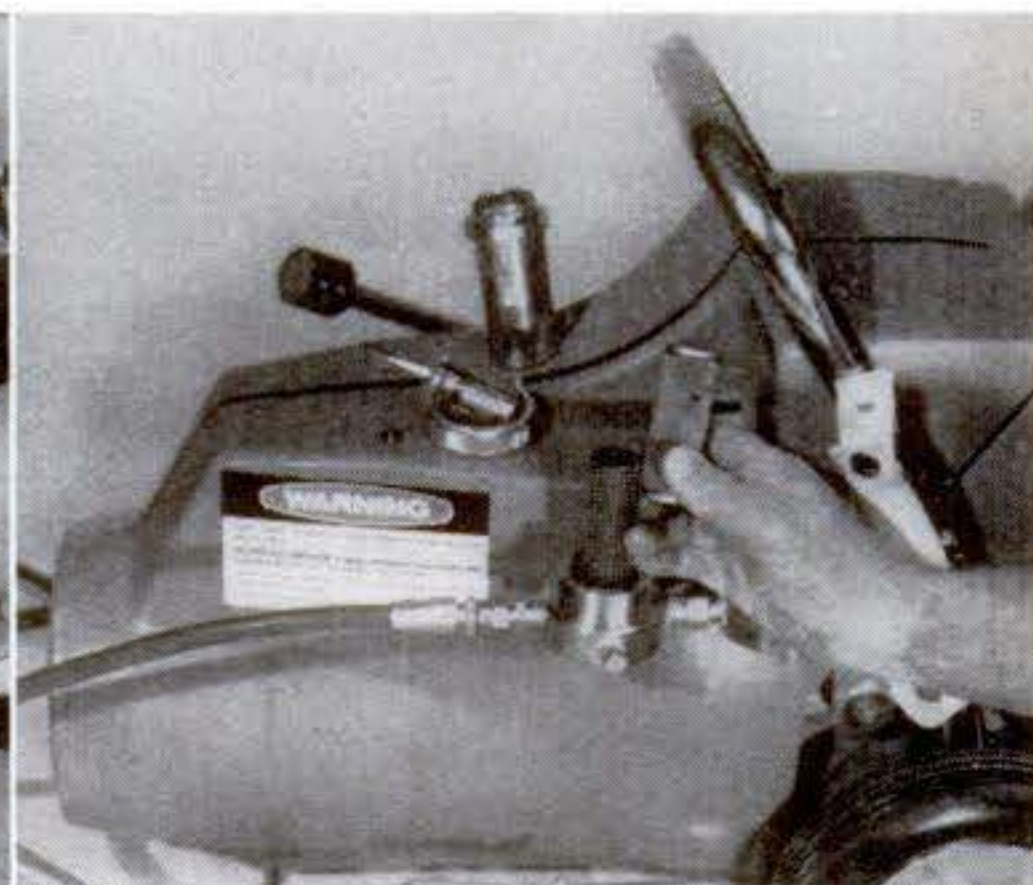
If you can't find a local renting agency, write Graco, Inc., Box 1441, Minneapolis, Minn. 55440. **PS**



Dropping pickup in paint bucket starts you off. Just let it feed through and you're ready to go. The paint goes on at nearly a half gallon a minute.



Carbide nozzle (foreground) can be changed to control the flow, match needs of different paints. The spray gun can handle 5000 pounds; has a safety lock.



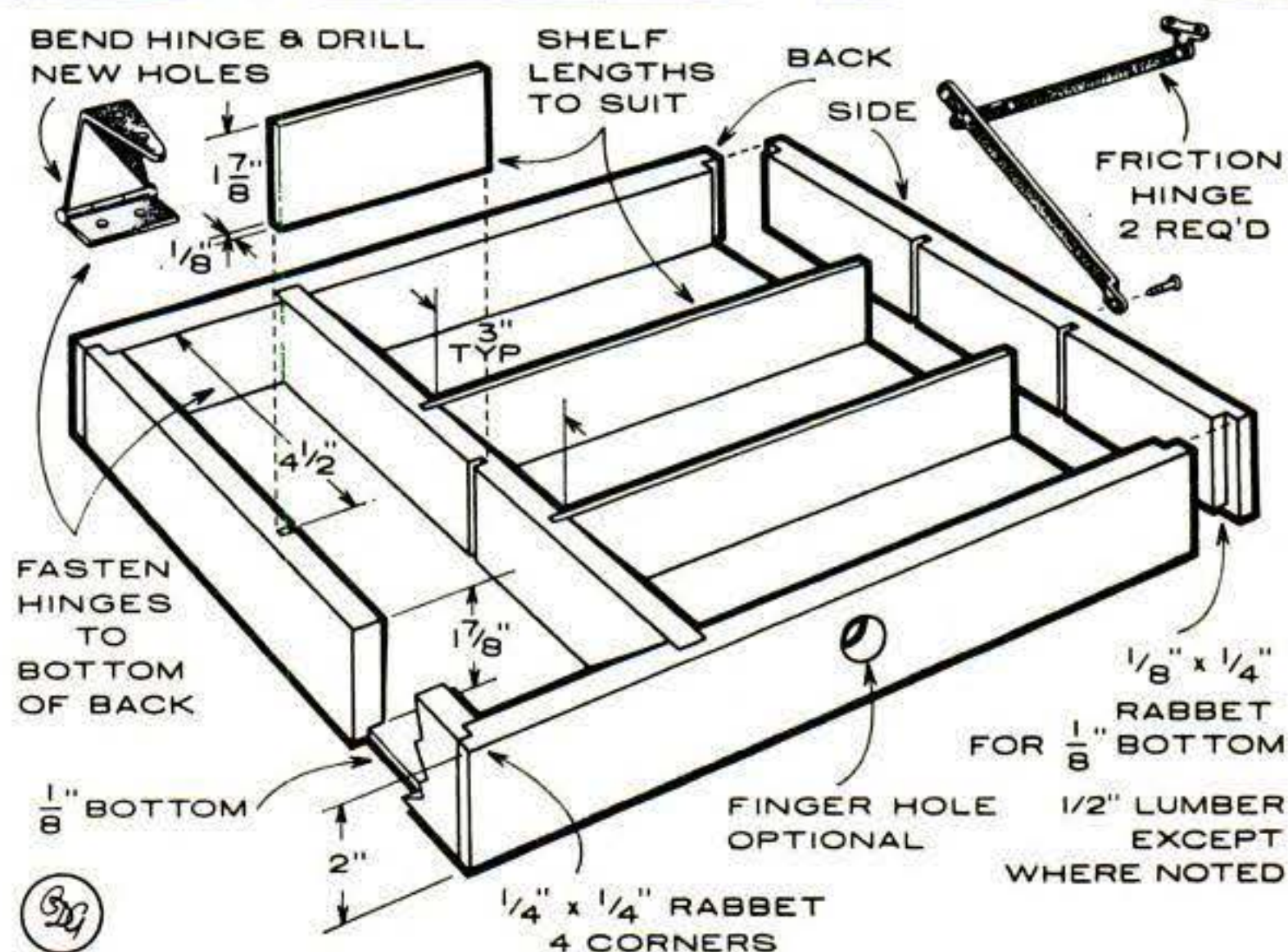
Screen prevents passage of sludge and any foreign matter (although, of course, paint should be clean). Screen is easily removed for cleaning.



UNDER-CABINET SPICE RACK

My wife likes to keep a variety of spices handy, and she prefers to leave them in their original containers, since these are usually better dispensers than those standardized spice-rack units. But storing these odd-shaped little cans and jars in a cupboard proved impractical. In digging through them for the spice needed, she usually sent others cascading onto the counter below.

So I designed this shallow pull-down tray that snugs up under the cabinets. It's hinged along the rear edge, with folding supports at each end that hold it for eye-level selection without letting it swing down enough to spill the contents. Match the tray length (and finish) to your cabinets; compartmentalize it to take the spices you normally keep on hand. A simple catch or hook holds the tray closed. Full counter space is then usable and the rack is virtually unseen.—*Jerry Van Dyke*



No-Space Can Storage for Kitchens: Two Ideas

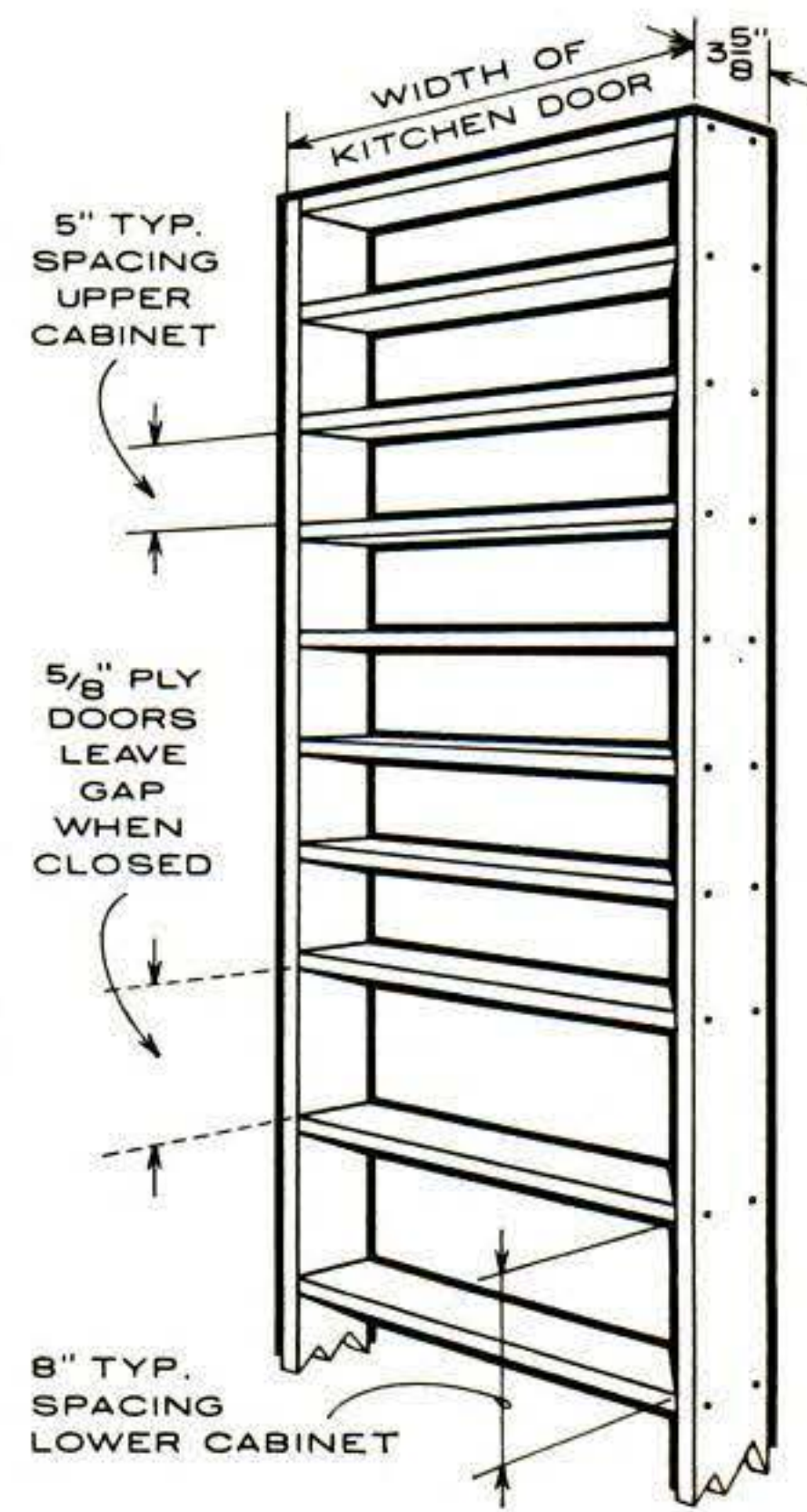
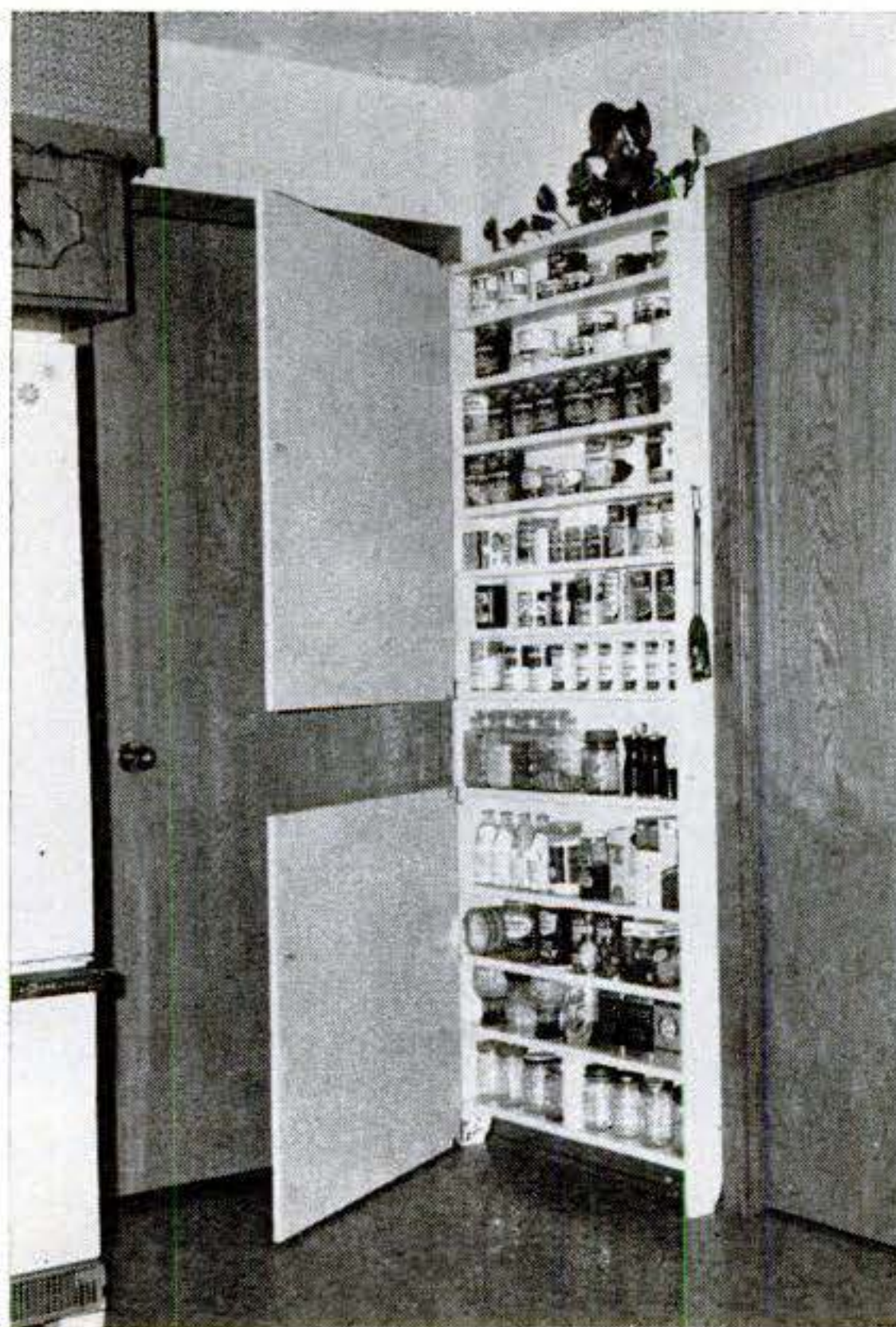
BEHIND-DOOR PANTRY

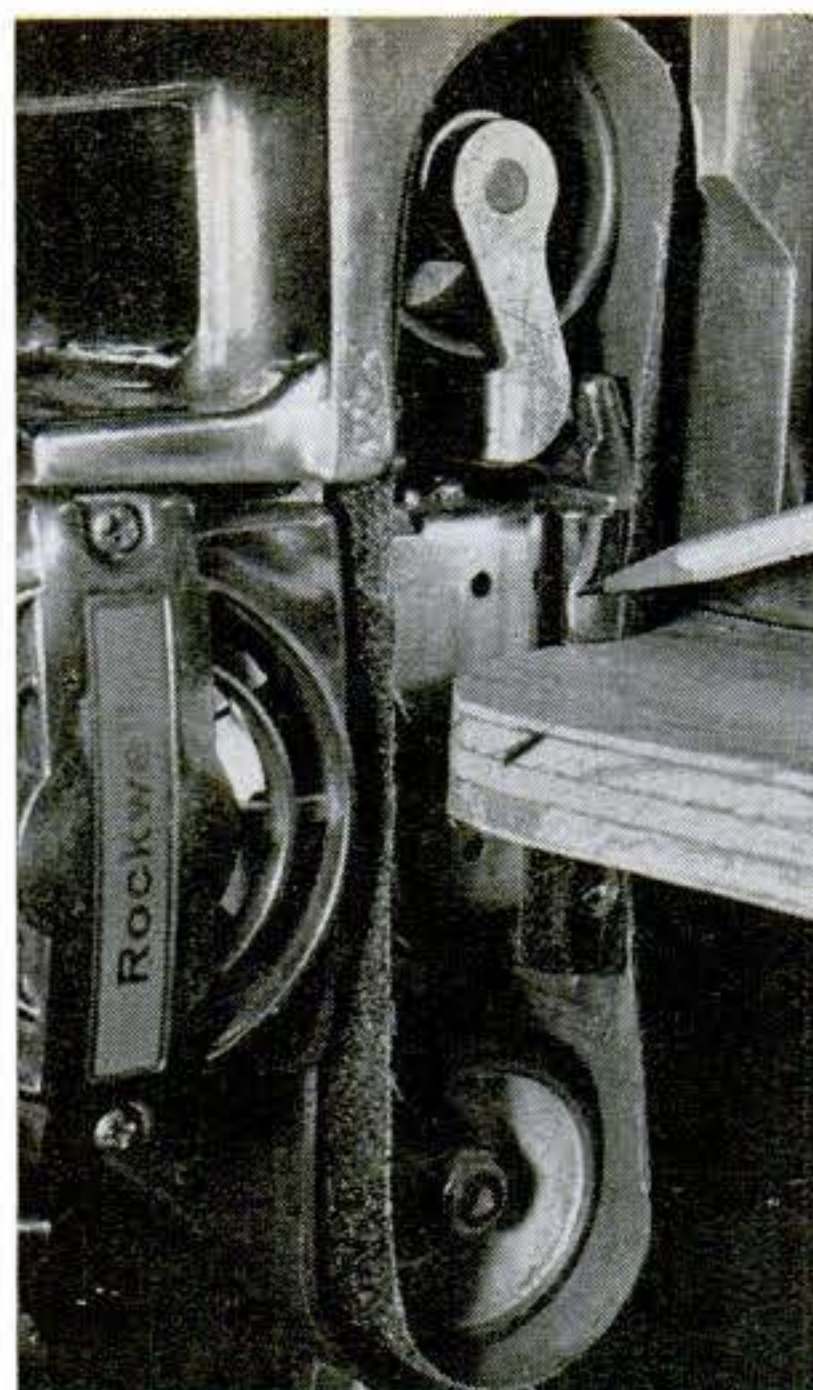
In today's overcrowded homes, it's a bonus if you can utilize space you didn't know you had. Does your kitchen door open against a corner? If so, what possible use is that wall space—scarcely deeper than the jamb trim? It was going to waste in our kitchen, yet we were short of food cupboards. So I tucked in this canned-goods rack, the same width as the door panel.

The fact that the rack is only one can (or bottle) deep is a plus—you can inventory your stock at a glance. Details I'm proud of:

- That open shelf creates a recess at doorknob height so the door still opens fully.
- Since no protruding pulls were possible I used touch-type latches.
- No need for a space-stealing back panel—screw the rack directly against the wall with cleats or metal angles.

—*Don Kirk*





Sanding edges smooth and to a perfect 90-degree angle is a snap for the Edge-A-Neer. Loosen wingnut on adjusting bar and you can adjust the table to any angle you choose.

Sand inside radii with a belt sander? Adjust belt to overhang round bar mounted to sander; attach table across rotation plane.

EDGE-A-NEER

If you own a Rockwell 153 belt sander, or a Stanley, Millers Falls, Craftsman, or Makita, you're in

luck. All these 3"-by-21" sanders will take the Edge-A-Neer, a new attachment I've become attached to over the past few months. Bolt the Edge-A-Neer to any of these sanders and

you have a tool that combines the precision of a stationary bench sander and the flexibility of a portable. Some of the jobs it has done for me include:

- **Door sanding.** Sanding door edges on a stationary tool is tricky. The door is too bulky to handle. With the Edge-A-Neer, you clamp it in a vise and guide the sander over it. Lots easier, and you get precise 90-degree edges—or any angle you want.

- **Countertop trimming.** The tool will put a perfectly smooth edge on a countertop or tabletop. It leaves behind an ideal surface for laminates and veneers.

- **Power planing.** I use the tool to "power plane," especially handy on end grain; it won't chip the wood.

The Edge-A-Neer is well made. The main body is polished cast aluminum. The adjusting table is faced with plastic laminate. This provides a smooth surface that can't scratch your work. Attachment or removal takes about a minute. Adjustments of table angle take only seconds.

The attachment is made by C.B. Enterprises (7701 Telegraph Rd., St. Louis, Mo. 63129) and \$79.95 will get you one.—A. J. Hand

Two Tools That Sand Away

SAND-O-FLEX

I used to hate the job of sanding any irregular, contoured surfaces—things like moldings, carvings, and spindles. Now, I actually enjoy it. The reason is Sand-O-Flex. This little sander works better than you have a right to expect it to.

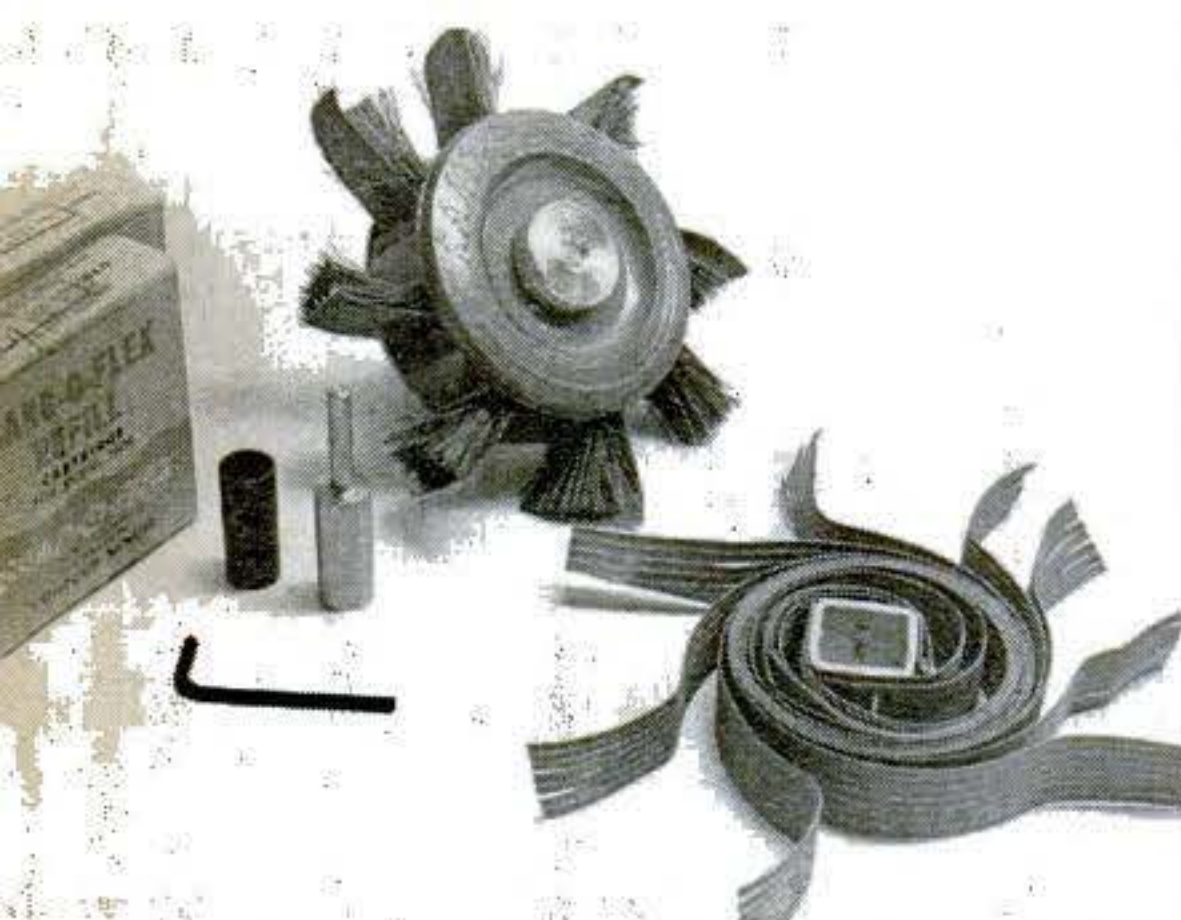
Sand-O-Flex is a rotary sander you chuck in your drill or drill press. Eight tufts of stiff bristles around its rim force strips of sandpaper into

nooks and crannies, around ridges and protrusions. It reaches everywhere, leaving behind it a surface as smooth as you can sand by hand. And it does so in about a tenth of the time you'd spend hand sanding.

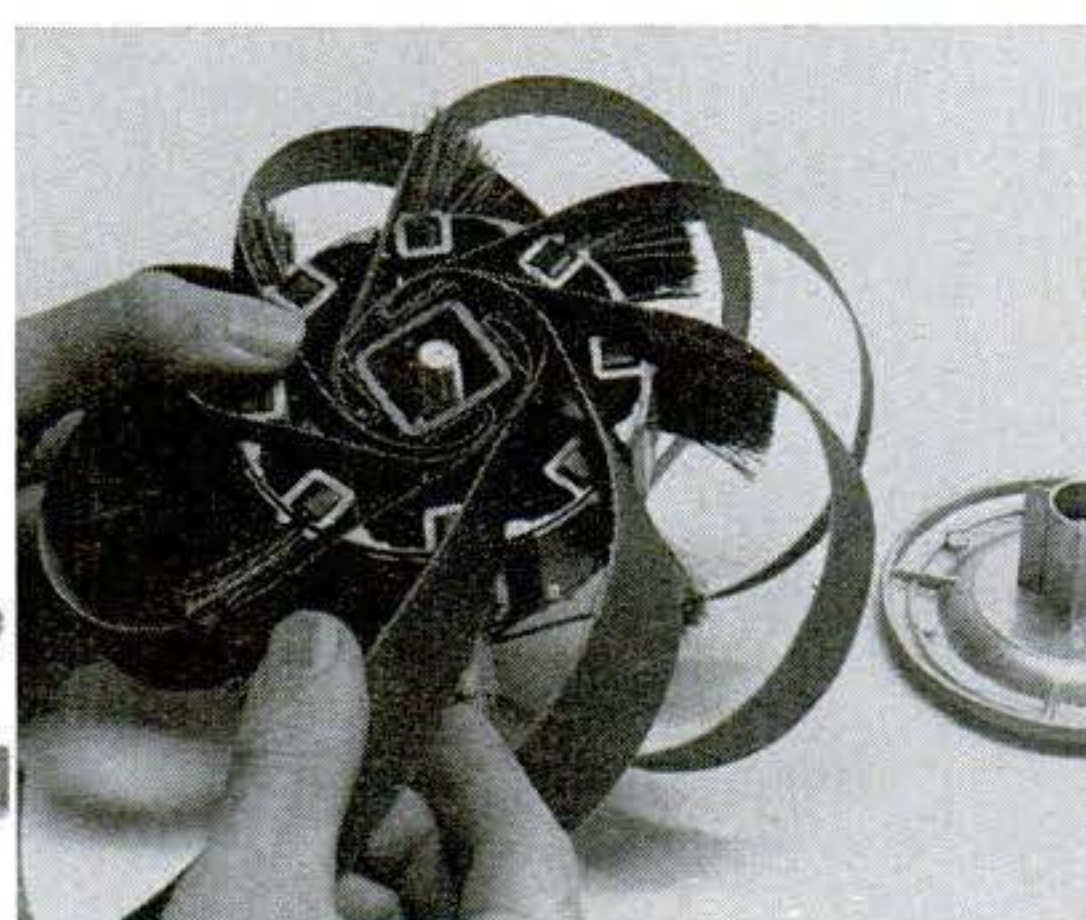
I've used it on hardwood and soft. The results are always outstanding. Examples? The Sand-O-Flex took off all tool marks on a hand-carved bird in about five minutes, leaving the pine wood ready for paint. It did the same for maple salad servers.

I used it to clean the old finish off carved furniture legs, and I now always touch up my router and shaper work with the tool. It works well on metal, too.

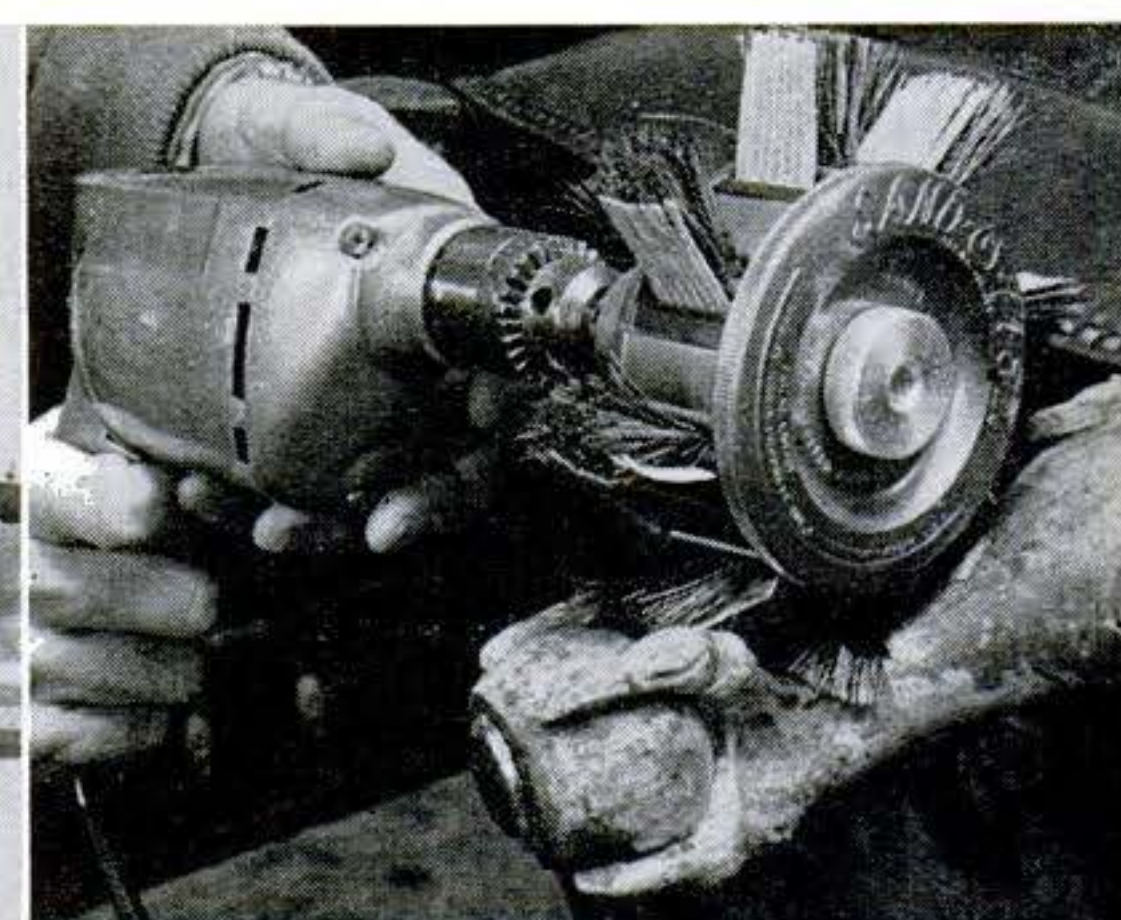
Sand-O-Flex comes in several sizes, but kit 35 is best for home-shop use. This \$20 kit includes the sander, refills, and an adapter to chuck the little tool in your drill. You can buy it at stores or from Merit Abrasives, 201 W. Manville, Compton, Calif. 90224.—A. J. Hand



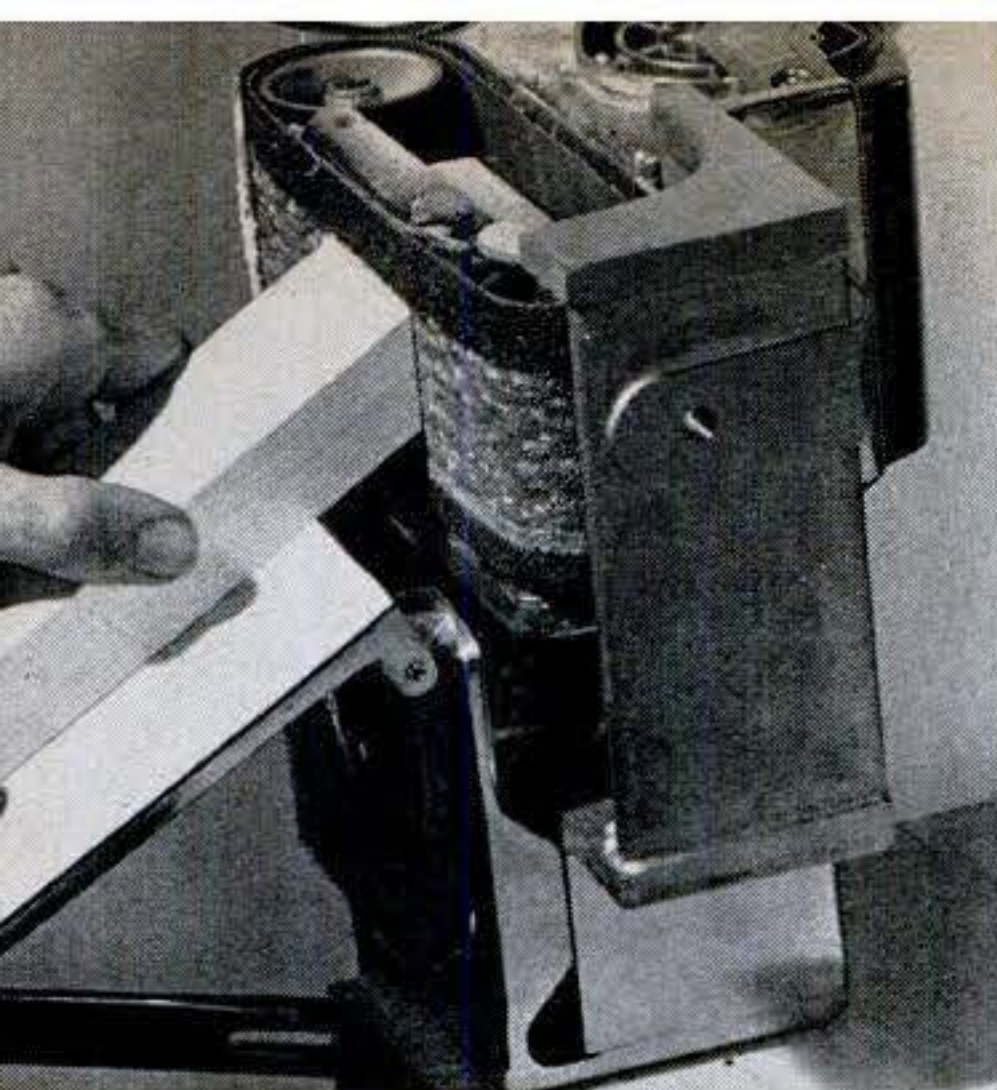
Tucked into Kit 35 is sander, adapter spindle, and abrasive refills. Refills come in two types, scored and unscored. Scored type conforms best to work.



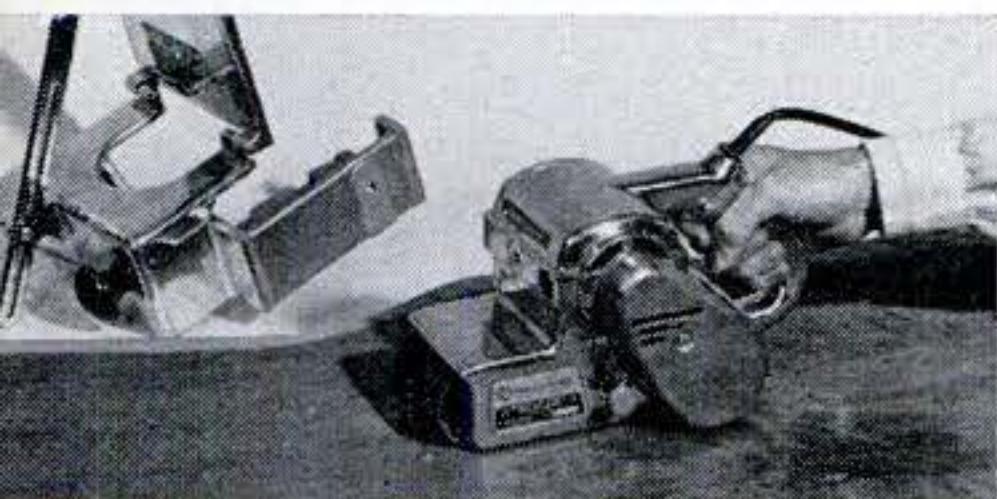
To load refills remove cover and insert strip ends into slits in the rim. Replace the cover and turn it to wind in the strips to correct working length.



On large work, use the sander in a portable drill. As abrasive strips wear, just feed out fresh abrasive and snip off the old. This takes just seconds.

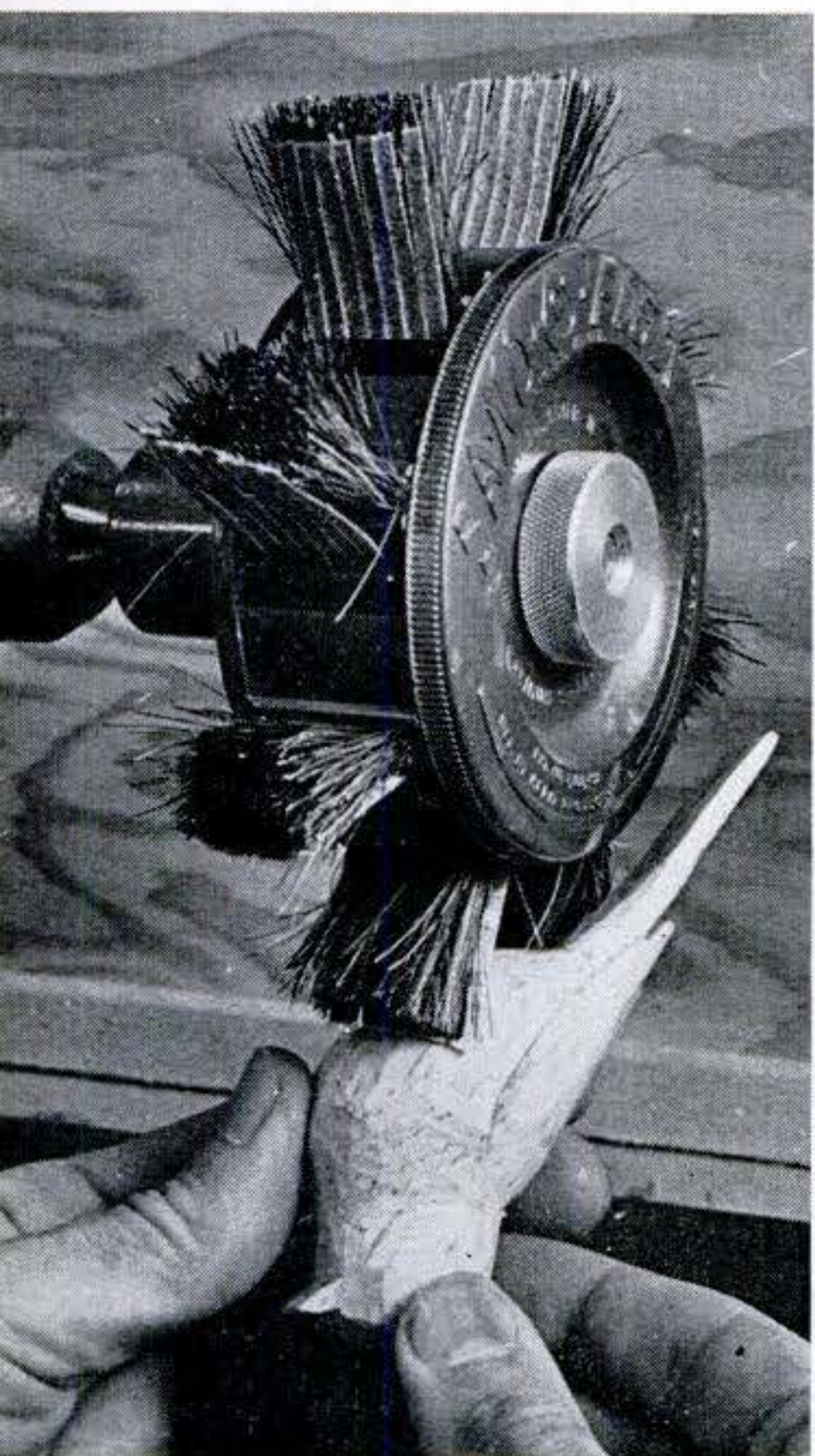


Want a stationary belt sander? Bolt the sander to a solid worksurface. Here the Edge-A-Neer table has been set to sand a perfect 75-degree angle.



Attachment comes off in about a minute, to return your belt sander to its original work mode. Shown here—Rockwell's 153, a perfect mate for Edge-A-Neer.

Problems



On small work, it's easier to chuck sander in a stationary tool, and hold the work. The sander won't grab the work, and won't hurt if it hits your fingers.

PERSONAL-USE REPORT

A No-Brush, No-Sand Way to Refinish

Hope's Refinisher and tung oil work very well on small jobs. For a major job, though, says Hand, you'll save time using the slop-on, hose-off speed of a water-wash remover.

A new finishing-refinishing system that is unique and remarkable is making its way into paint and varnish outlets. The name is Hope's.

It's remarkable because the remover—the Refinisher—is pure solvent; no waxes, thickeners, or saponifiers—no gooey mess. You pour a little in a pan, dip a wad of steel wool into it, and swab the old finish. Gradually it softens and loads the steel wool. Dip and squeeze the steel wool in the solvent, it drains clean, and you go on with your work. You end up with beautifully bare wood.

Pour the used solvent back in the can. The solids settle out and you can use the liquid over and over.

It's unique because the refinishing material is pure tung oil, the toughest, most water-resistant and wear-resistant of all the oils used in wood finishing.

I tried tung oil side by side with leading brands of penetrating finish-



es using other oils and resins and found some notable differences:

- Pure tung oil gives a slightly darker, richer color to the wood, accenting the grain.

- When you wipe it off (in the standard swab-on, let-stand, wipe-dry process), the tung-oil finish is ready for use immediately.

- The "build" is almost zero, giving you great wood textures. Successive coats—up to three—increase the soft luster slightly without filling the textures.

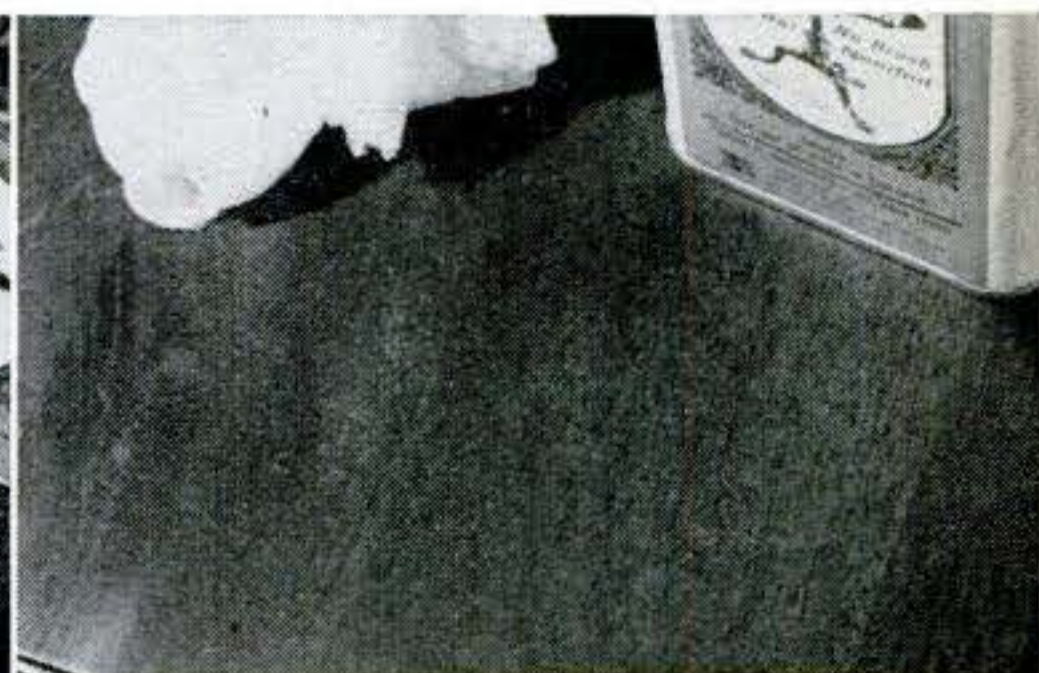
- Resistance to such things as alcoholic beverages is remarkable.

- Sloppiness is almost nil.

The new refinishing products are made by the Hope Company (Hope Finnegan, prop.), Box 25-A, Chesterfield, Mo. 63017. If your dealer doesn't have them yet, Hope will mail them to you postpaid, at \$6 a quart for the remover, \$4 a pint for pure tung oil.—*Jackson Hand*



Before and after: The finish on the tabletop above had just about everything wrong with it. At right, after Hand stripped the old finish with Hope's Re-



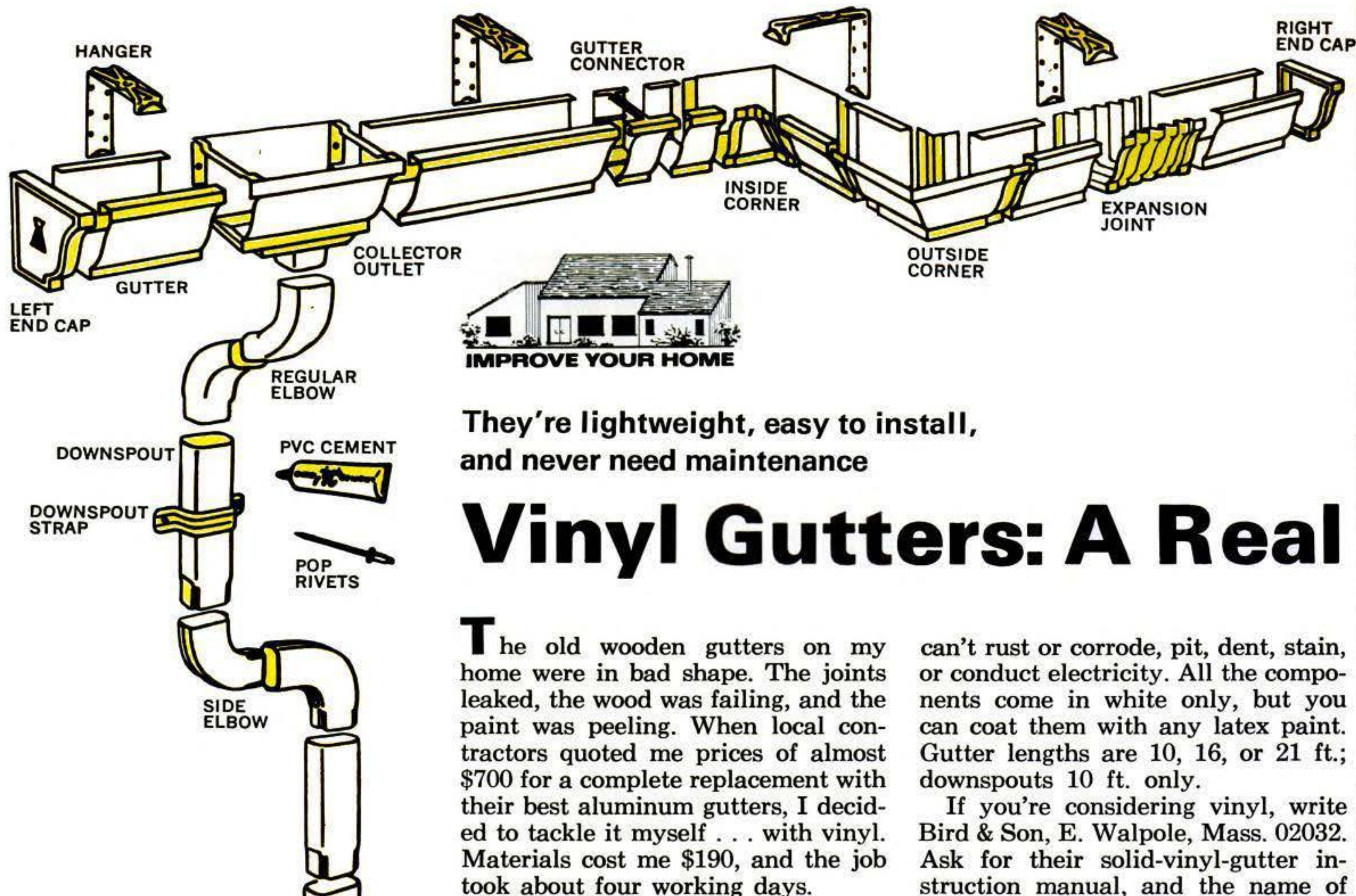
finisher and finished with Hope's tung oil swabbed on with a cloth, the natural wood shows through. Excellent color and sheen, he reports.



Refinisher's solvent action combines with gentle abrasion of fine steel wool to dissolve the old finish (left). You dip and squeeze the steel wool in the solvent



and continue swiping away until the wood is clean (right). The Hope process is not intended for paint—only for lacquer, varnish, or shellac.



Complete line of vinyl gutter components is shown above. Before you start work, sit down and lay the whole job out on paper. Figure out a shopping list, and get a little extra gutter so you can practice cutting and joint techniques.

They're lightweight, easy to install, and never need maintenance

Vinyl Gutters: A Real

The old wooden gutters on my home were in bad shape. The joints leaked, the wood was failing, and the paint was peeling. When local contractors quoted me prices of almost \$700 for a complete replacement with their best aluminum gutters, I decided to tackle it myself . . . with vinyl. Materials cost me \$190, and the job took about four working days.

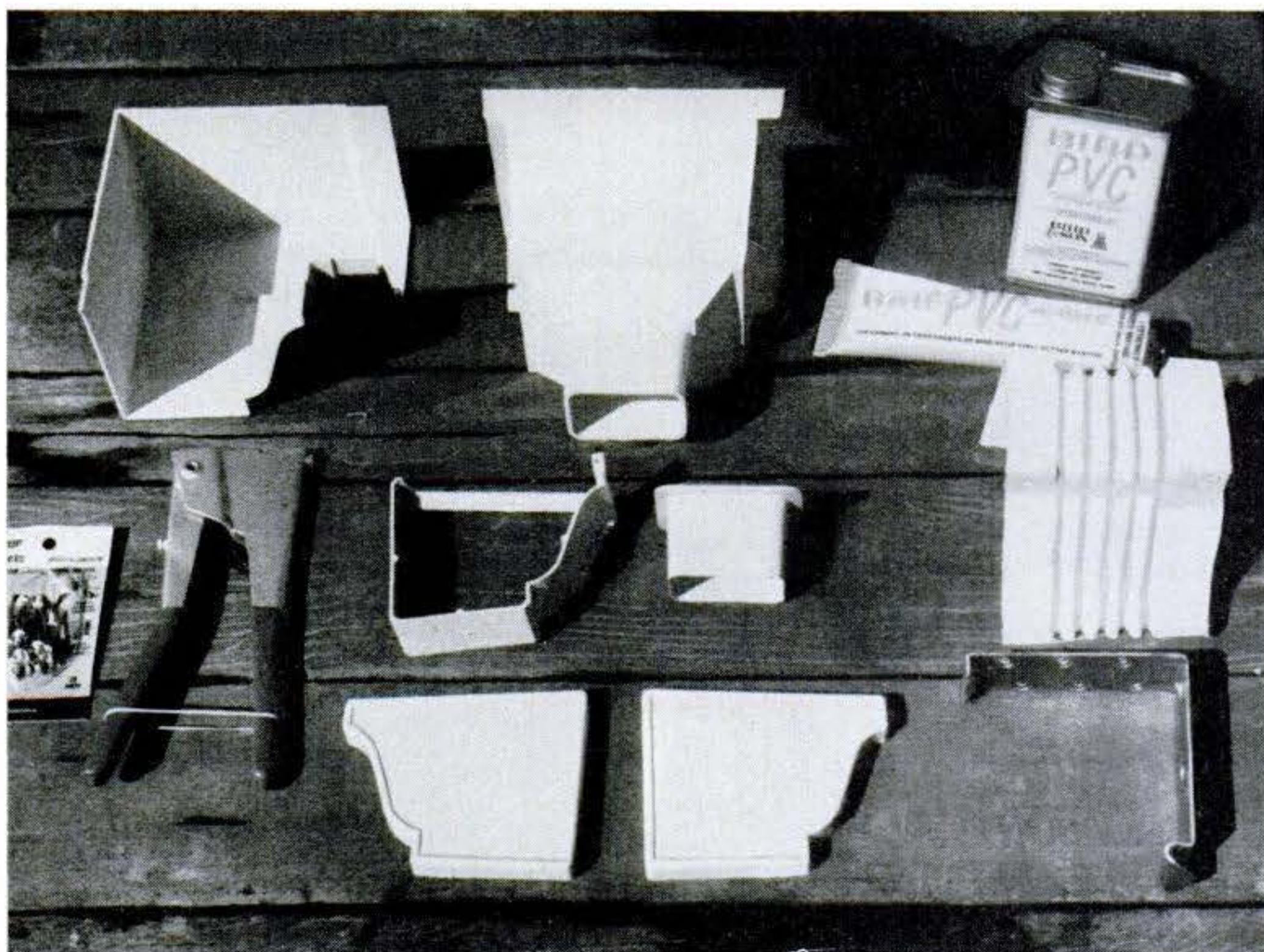
Why vinyl? Although it costs almost 30 percent more than heavy-duty aluminum, vinyl has advantages that—for me—outweighed the price difference. Vinyl gutters are easy to install, and maintenance-free. They

can't rust or corrode, pit, dent, stain, or conduct electricity. All the components come in white only, but you can coat them with any latex paint. Gutter lengths are 10, 16, or 21 ft.; downspouts 10 ft. only.

If you're considering vinyl, write Bird & Son, E. Walpole, Mass. 02032. Ask for their solid-vinyl-gutter instruction manual, and the name of your nearest dealer. The manual is a big help, but I used a slightly different method of making joints, and less pitch than recommended. I learned these tricks from a contractor who specializes in vinyl gutters. **PS**

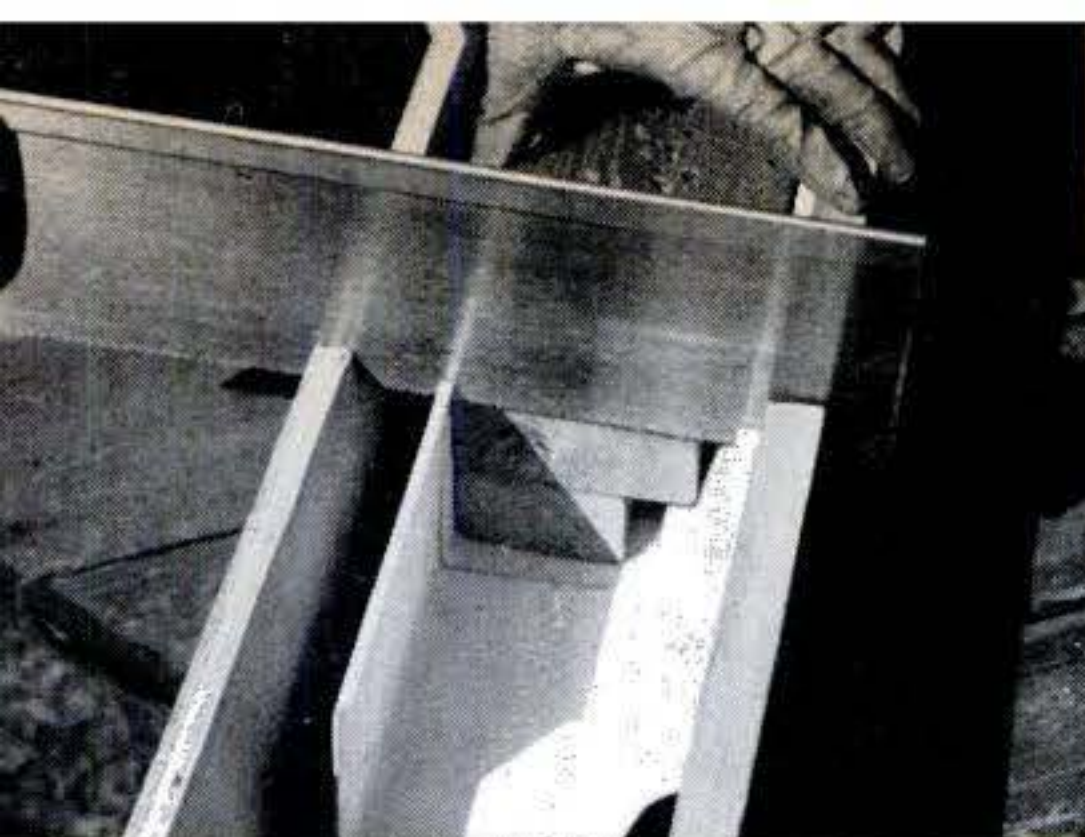


1 Remove your old gutters—if you're doing a replacement job. Metal gutters can be pried off with a wrecking bar, wooden gutters should be split and pulled off in pieces. Work carefully to avoid damaging the fascia.

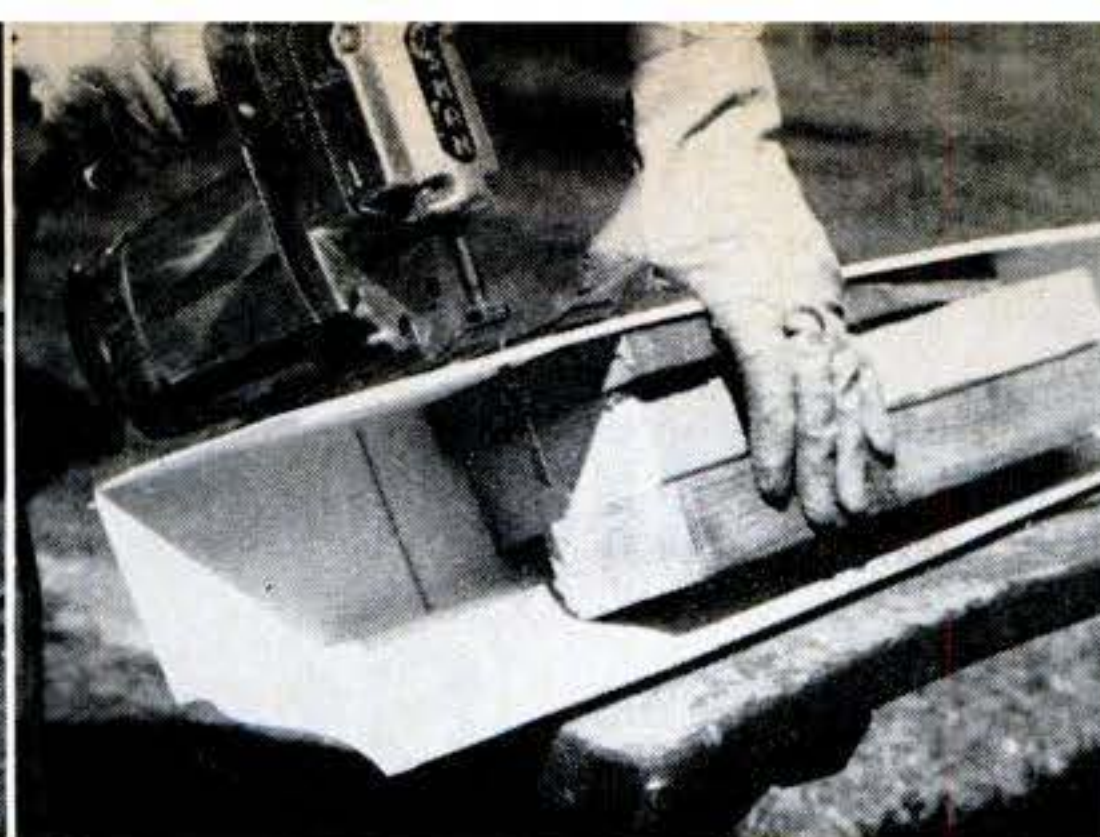


2 Cracks and holes in the fascia boards should be filled with wood putty. Then sand, prime, and paint before beginning installation. Replace any fascia that's rotting, or that was damaged beyond repair by the gutter-removal process.

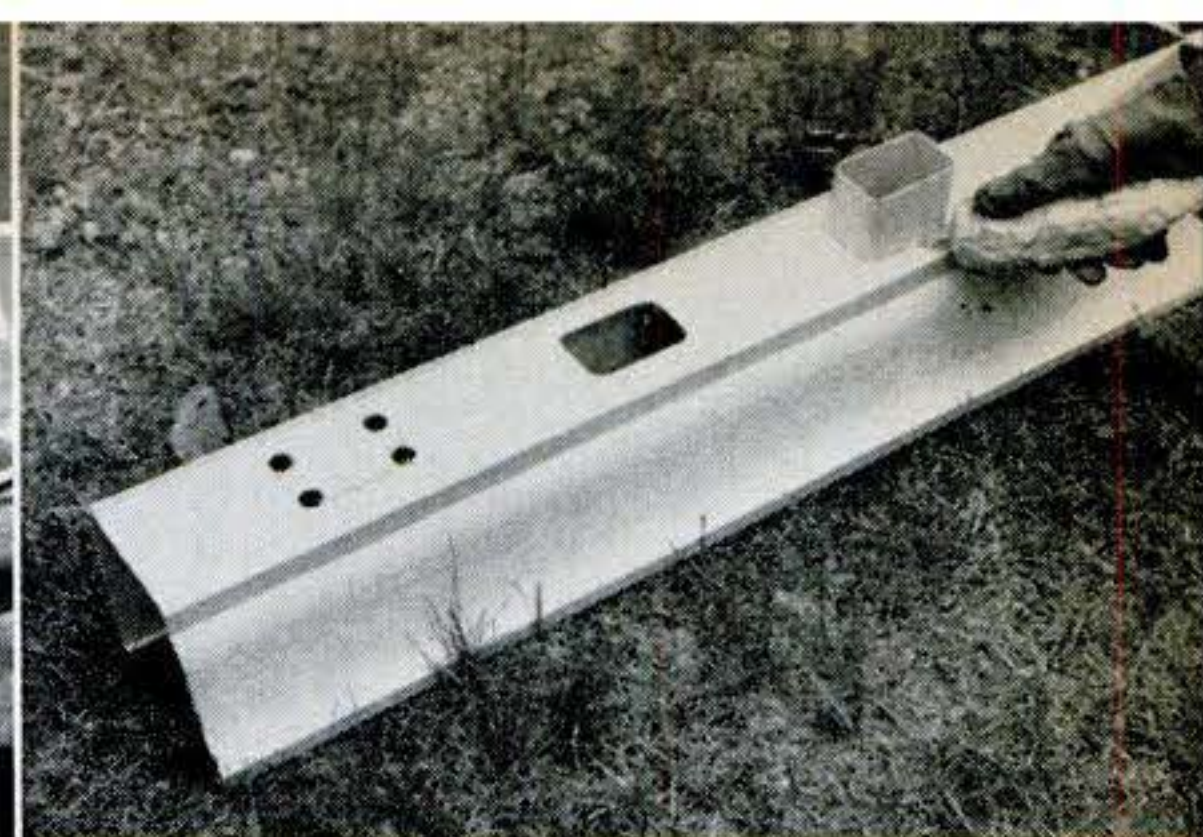
3 Basics for gutter work include blind rivet tool and rivets, PVC primer and cement, plus components required for your installation: inside corner, collector box or outlet tube, connector, end caps, expansion joint, hangers.



4 If cuts are required, use miter box and fine-toothed saw. Insert wooden filler blocks into the gutter to keep it from flexing and chattering. Whenever possible, try to connect the factory cuts; your joints will fit better.



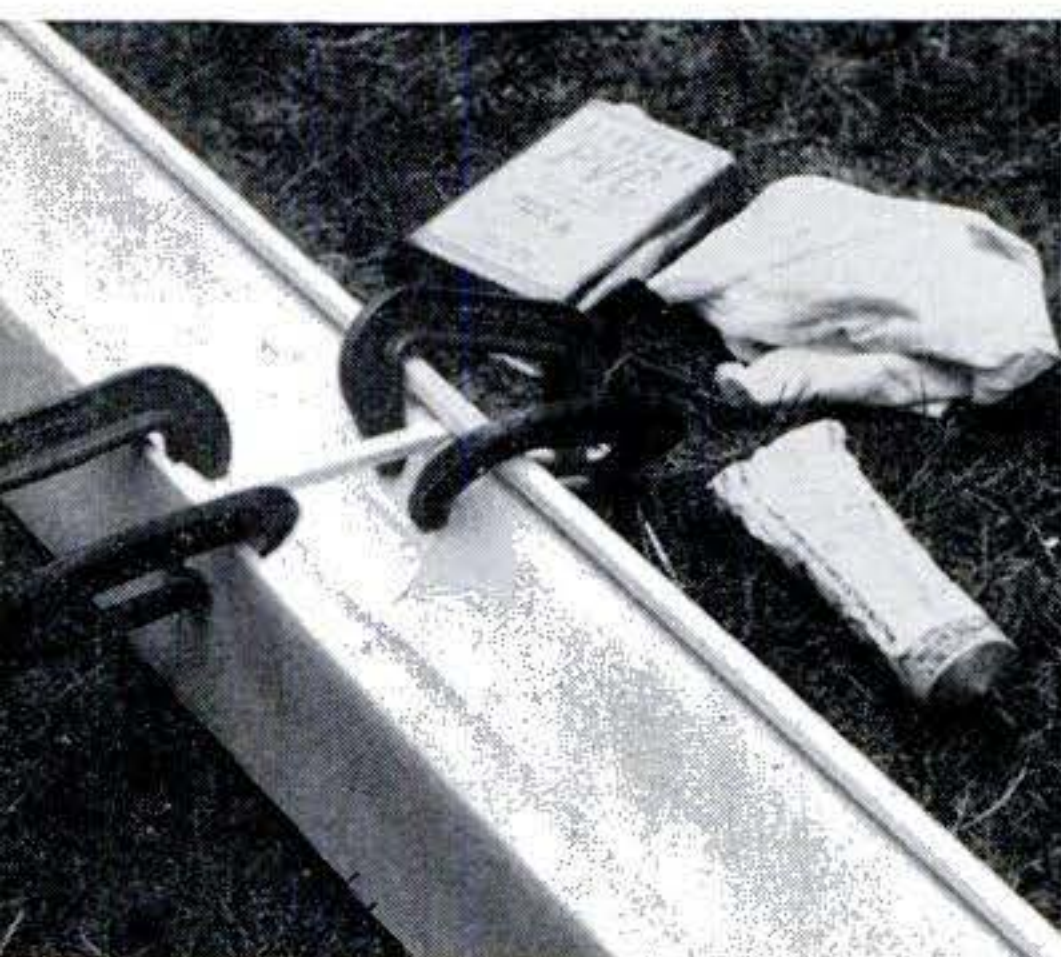
5 You can use a saber saw to speed your work on non-butting cuts. These include cuts for end caps and corner pieces. These cuts needn't be as smooth as cuts for butt joints, but for clean work use a fine-tooth blade.



6 Three steps in installation of outlet tube are shown above. Scribe outline of tube on gutter, drill $\frac{5}{8}$ " corner holes, cut opening, and cement tube in place. The ready-made outlet boxes do the same job with a lot less work.

Do-It-Yourself System

By ARTHUR GLOWKA



7 Good joints are made by wiping gutter ends and connector with PVC primer. Then run a liberal coat of cement on outside of connector, place it inside the joint, lapping both pieces equally. Clamp and let set for 30 minutes.



8 Pop rivets instead of clamps are recommended by Bird, but author used clamp trick on advice of a local gutter contractor. After letting joints set author then drilled and riveted. He says his joints are stronger than gutter.



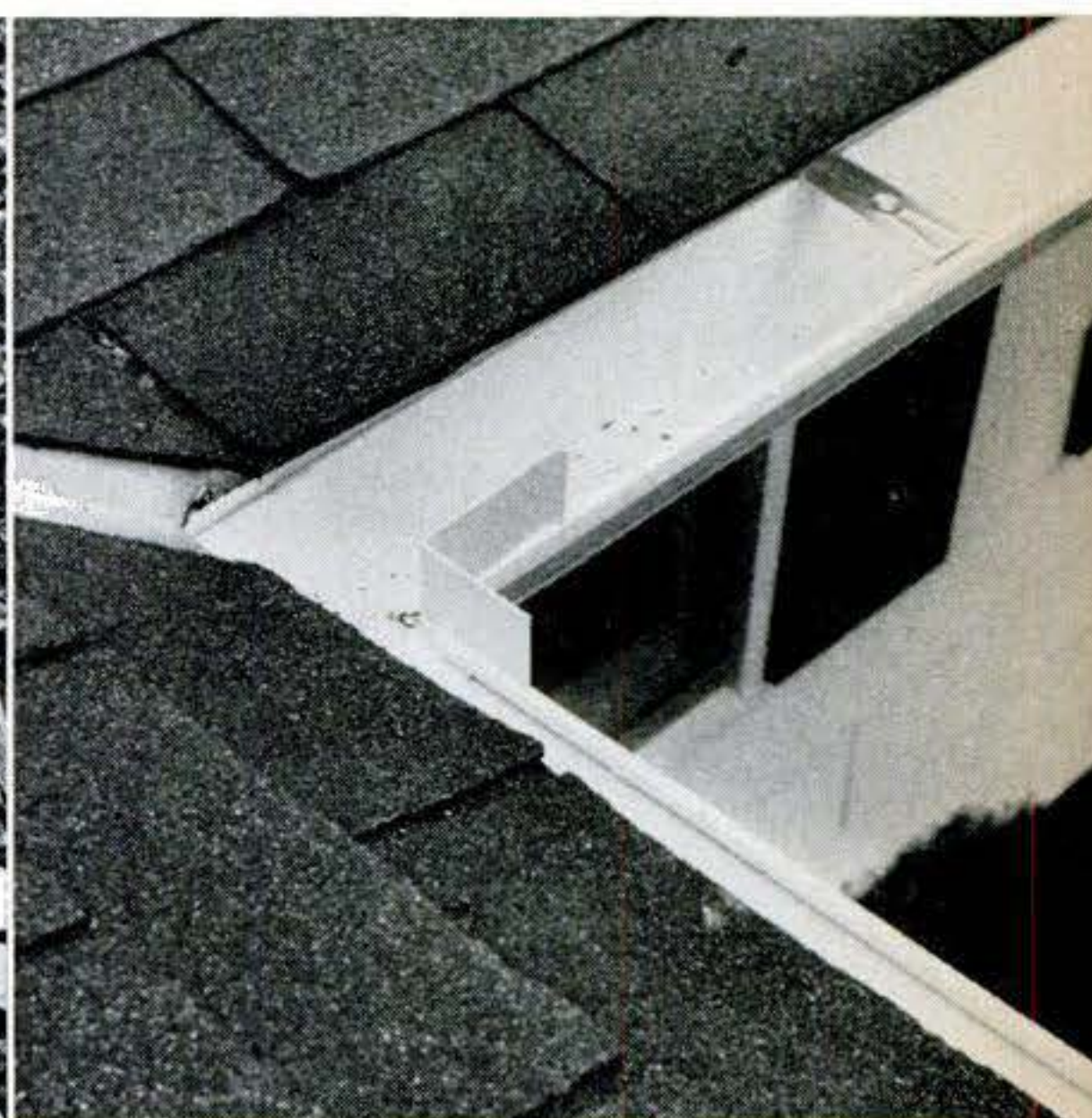
9 Hangers go up like this: Temporarily nail outlet boxes in place, aligned with existing downspouts. Then use a taut line to align hangers. Bird recommends $\frac{1}{8}$ "-per-foot pitch, author used less. Put hangers on 18" centers.



10 Adjust final position of collector boxes. Then, using elbows and downspout pipe, fabricate the piece that runs under the soffit. If your existing downspouts are in good condition, use them. Otherwise, replace with vinyl.



11 Cut connected gutter sections only after measuring run and allowing at least 1" to extend into each collector. Snap gutters into hangers. Gutters must float freely on hangers without binding to allow for expansion/contraction.



12 Use scrap vinyl to make crickets if needed. Crickets will prevent excess water from overpouring gutter at locations of high-water runoff. Shown above is a cricket at one such location, a valley where two roof lines meet.

New High-Style Hinges Make This a Store-All Table

Without visible screws or barrel, sculptured hinges dress up four storage bins

By AL LEES
DESIGNED BY GARY GERBER

A well-designed cocktail or coffee table should do more than provide a place to rest refreshments. It should corral the clutter of your living room or den by offering tuck-away storage compartments. But this function calls for multiple hinges, and the project would bristle with barrels, pins, and exposed screws if you used conventional hardware.

When we first saw Homecraft's new cabinet hinges we asked industrial designer Gary Gerber to use

them as a design element in creating a storage table that could take its place in any living room. The hinges have no visible pivots or screws to mar their richly sculptured patterns. They're easily back-mounted on standard $\frac{3}{8}$ "-lip doors by drilling two holes through the panel to take protruding screw sockets. An abbreviated hinge base, completing the exclusive integral-pin construction, is blind-mounted to the doorframe.

(If the Sculptura line isn't yet available at local stores, write for a brochure from Gries Reproducer Co., 400 Beechwood Ave., New Rochelle, N.Y. 10802.)

Construction of our table is deliberately simple. We chose mahogany-faced plywood (with matching veneer tape) and Baroque-pattern hinges and pulls in silver finish.

We cut cabinet parts to the sizes

shown (except doors, which we fitted last) and did all grooving prior to assembly. If you don't own a dado head, cut the grooves with repeat passes on a table or radial-arm saw, and clean up with a chisel.

Screw the 2" pedestal to the particleboard base before attaching the cabinet assemblies. Apply filler strips to both edges of the base, between these cabinets, to bring the open center section to full 20" width. These strips will be hidden by veneer tape on their sides and by the black plastic laminate used to face the exposed center recess.

This laminate is applied with contact cement, as on a countertop. For fitting ease, apply the laminate before the cabinets are anchored.

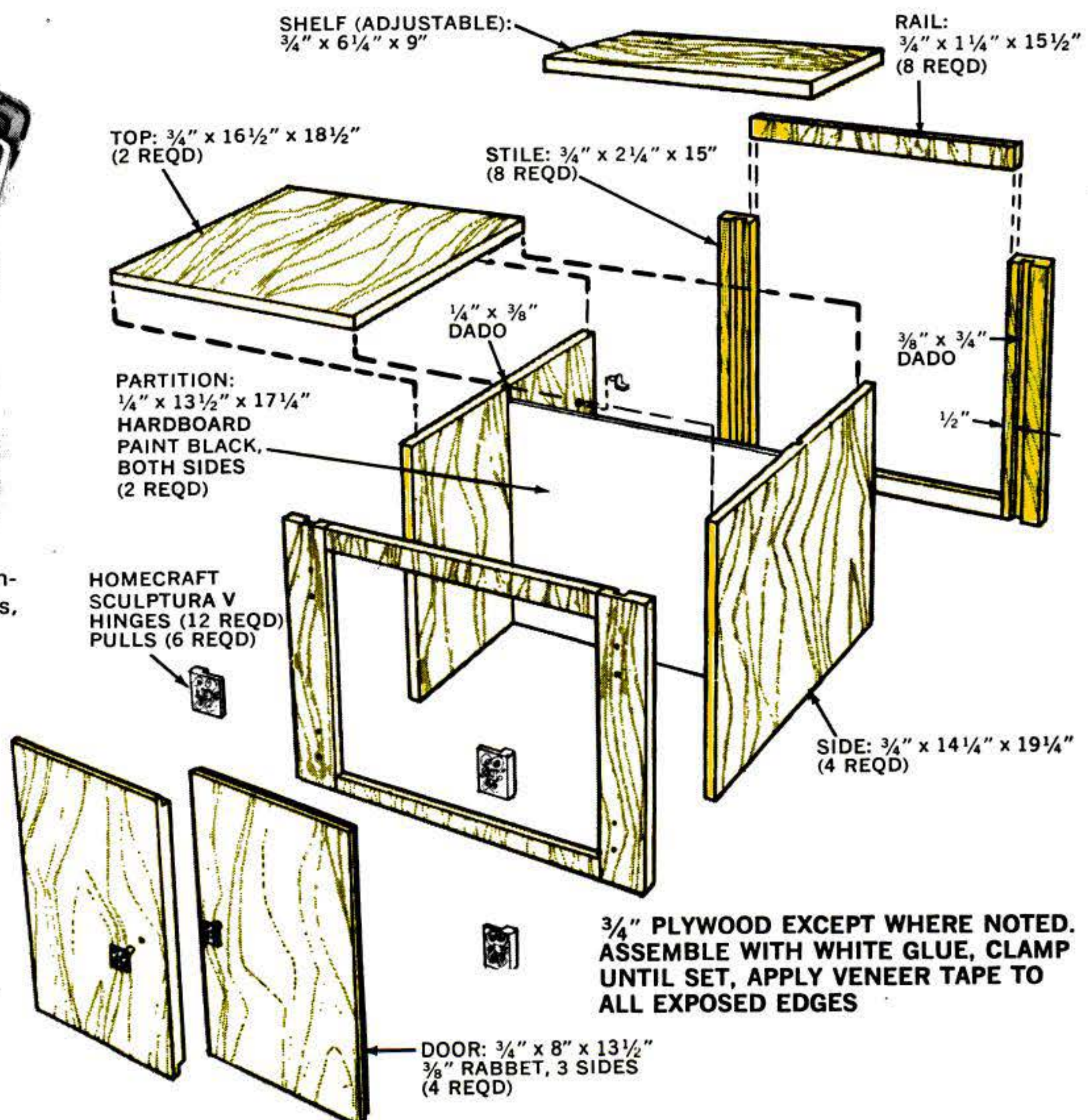
The acrylic top (which could be plate glass, if easier to find) is held in place by its weight alone. P.S.



Hinges come in five designs (matching pulls at top): Baroque, Fleur-de-Lis, Contempora, Florentine, Basketweave.

MATERIALS LIST

- $\frac{3}{4}$ " HARDWOOD PLYWOOD**
- 2 Pedestal end: 2" x 16"
 - 2 Pedestal face: 2" x 56"
 - 4 Side: 14 $\frac{1}{4}$ " x 19 $\frac{1}{4}$ "
 - 8 Frame stile: 2 $\frac{1}{4}$ " x 15"
 - 8 Frame rail: 1 $\frac{1}{4}$ " x 15 $\frac{1}{2}$ "
 - 2 Top: 16 $\frac{1}{2}$ " x 18 $\frac{1}{2}$ "
 - 4 Front door: 8" x 13 $\frac{1}{2}$ "
 - 2 Rear door: 6 $\frac{3}{4}$ " x 16 $\frac{1}{4}$ "
- $\frac{3}{4}$ " PARTICLEBOARD**
- 1 Base: 18 $\frac{1}{2}$ " x 60"
 - 2 Attached shelf: 6 $\frac{1}{4}$ " x 9"
- $\frac{1}{4}$ " HARDBOARD**
- 2 Partition: 13 $\frac{1}{2}$ " x 17 $\frac{1}{4}$ "
- $\frac{1}{2}$ " PLEXIGLAS**
- 1 Top: 20" x 60"

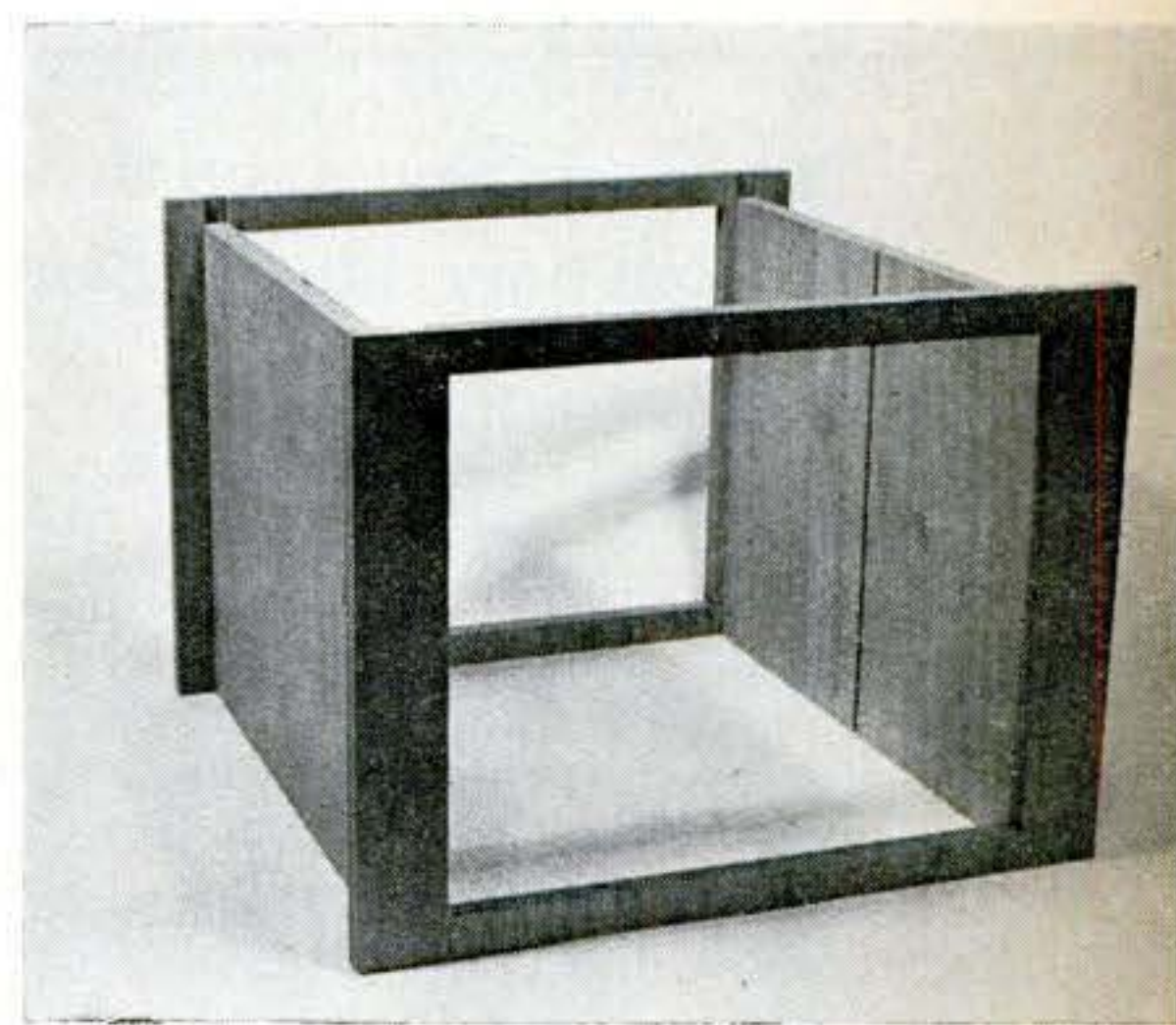
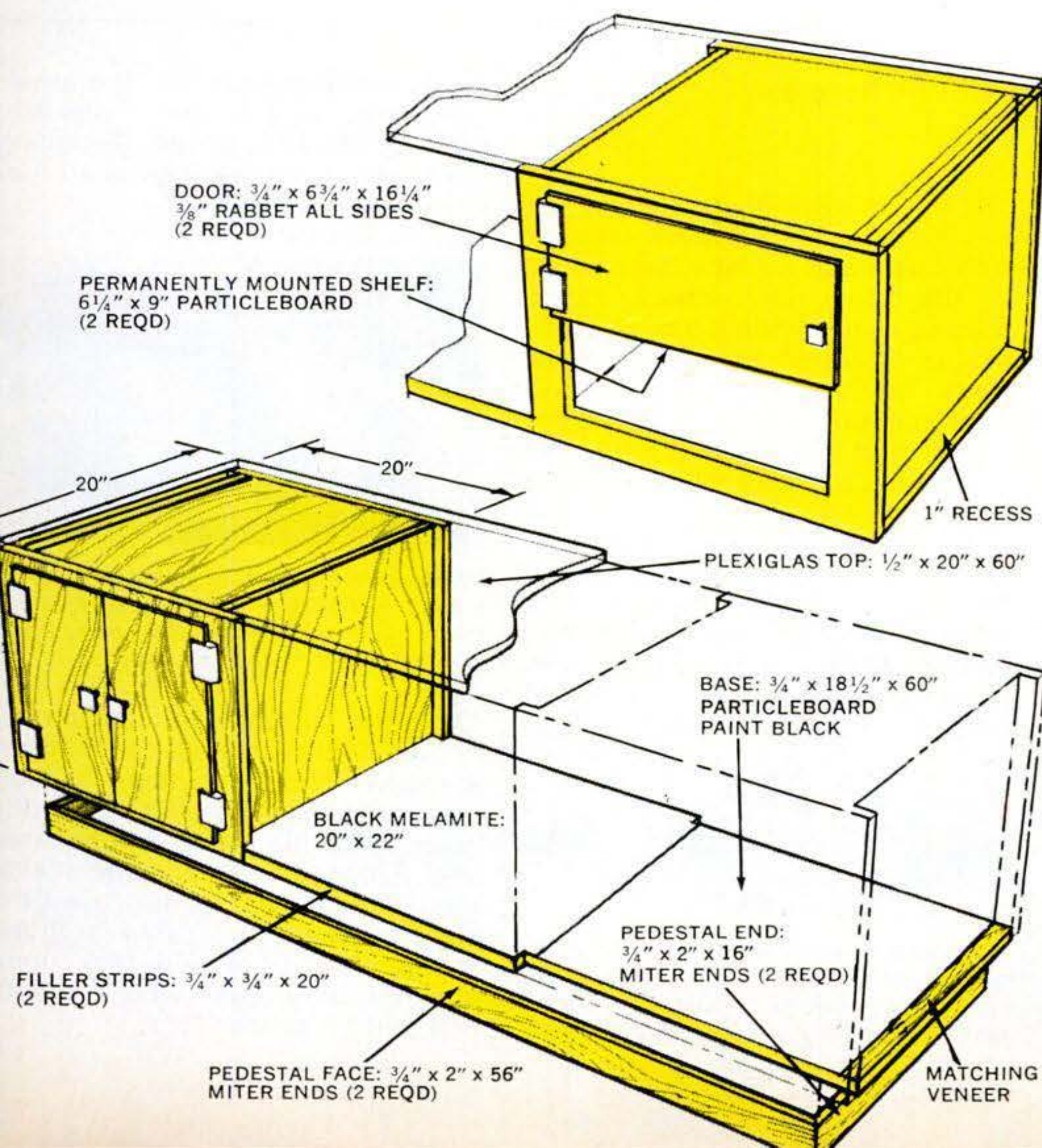


$\frac{3}{4}$ " PLYWOOD EXCEPT WHERE NOTED. ASSEMBLE WITH WHITE GLUE, CLAMP UNTIL SET, APPLY VENEER TAPE TO ALL EXPOSED EDGES



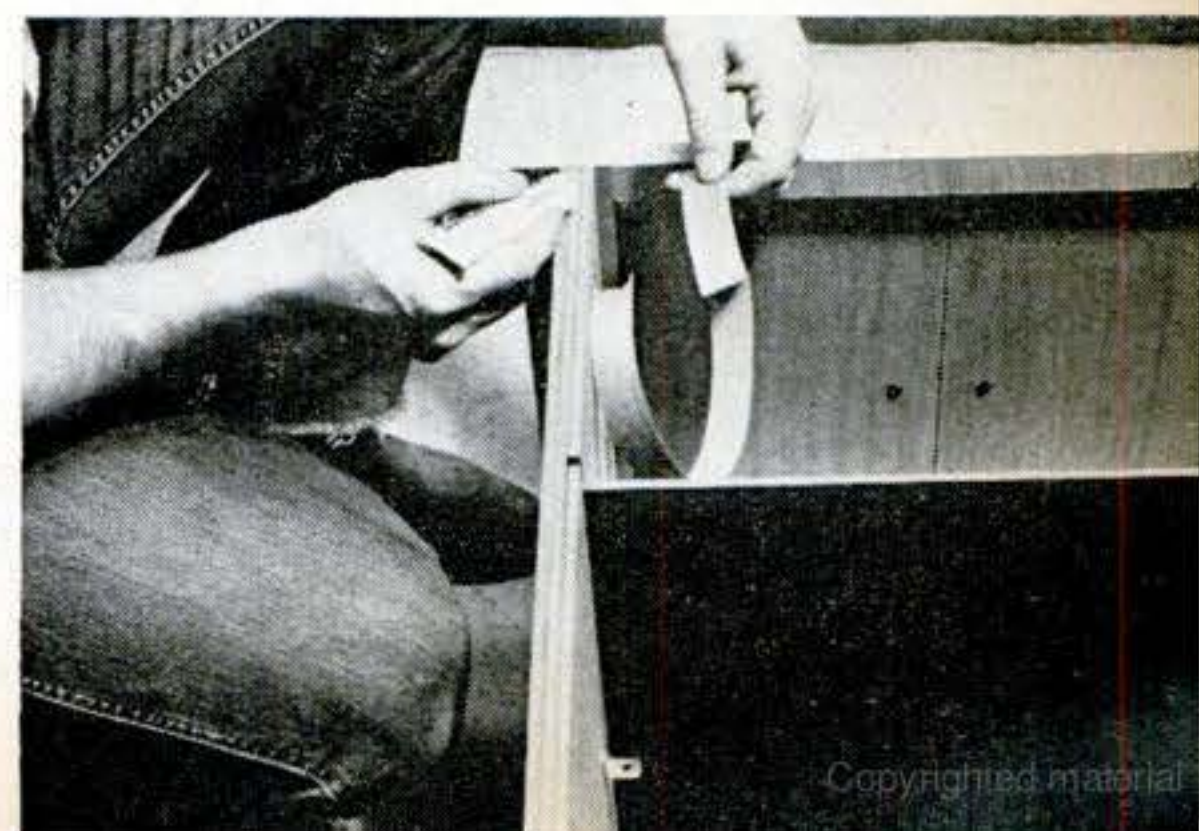
Generous storage compartments at each end keep bulky items handy but out of sight. Deeply embossed hinges are for $\frac{3}{8}$ "-offset doors, like those on

kitchen cabinets and bath vanities. About \$2.50 a pair in choice of antiqued finish.



Two cabinet shells are identical. Assemble face frames, then glue side panels into precut dados. Slip in partition.

Exposed plywood edges are masked with matching veneer tape after assembly. Let glue set, trim flush with sharp knife.



Troubleshooting Your Car's

Test your knowledge of starting systems with this quiz—seventh in a series

1 Engine locks up when cranking

Until a few days ago your three-year-old car started easily. But now there is a strange hesitation during cranking when you first start the car in the morning. The engine actually stops turning for a couple of seconds while it's being cranked, as if something is binding the pistons in the cylinders. Then it overcomes the resistance and continues to crank, and starts a few seconds later. There's no problem with how the car runs—only that mysterious hesitation during the morning's first start.

The obvious first suspect is the battery, but it tests fine at your local service station, and the cables and connections are clean and tight. The station even checks the current draw of the starter, but it's within limits. And the cranking speed is just as fast as it should be.

It's possible the starter teeth could be hanging up on the flywheel, so

you remove the starter to inspect the teeth on the drive, looking through the starter mounting hole while you turn the engine over to inspect the flywheel teeth. But everything here is in good shape.

An inspection of the starter solenoid shows the contacts are good, so there's no chance of trouble there. You are positive the starting system is in good shape, but still the engine is having trouble cranking on that first start in the morning. Where else would you look?

2 Slow cranking every time

Your car, old as it is, still starts, but only after much labored cranking. It sounds as if the starting motor is turning the engine very slowly, and the situation seems to be getting worse. The battery, cables, and the rest of the starting system are in good shape. So you know the trouble must be in the starter.

A teardown of the starter shows worn brushes and a considerable amount of the copper brush metal all over the brush holders. You have the commutator turned, and the ar-

mature checks out fine. The field windings are in good shape, so you replace the brushes and the starter looks brand-new.

Unfortunately, looks don't mean everything, because you still have the same problem. The new brushes didn't help a bit. It seems as if the starter is dragging on something. In desperation, you take the starter to an electrical-expert friend of yours. "Take it apart and let me see the armature," he says.

When you hand him the armature he points to the side of it and says, "There's your problem."

What exactly is he pointing to, and how does it indicate what the trouble is?

3 Slower and slower cranking

You know that corroded battery cable clamps can affect starting, but your car has a corroded battery hold-down nut, and that doesn't worry you enough to do anything about it. Also, one battery cable is old enough to have lost its insulation, but it has been taped to protect it. You figure that's okay, too. Then, surprisingly,

Think you've got the answers? Check here to find out how right you are

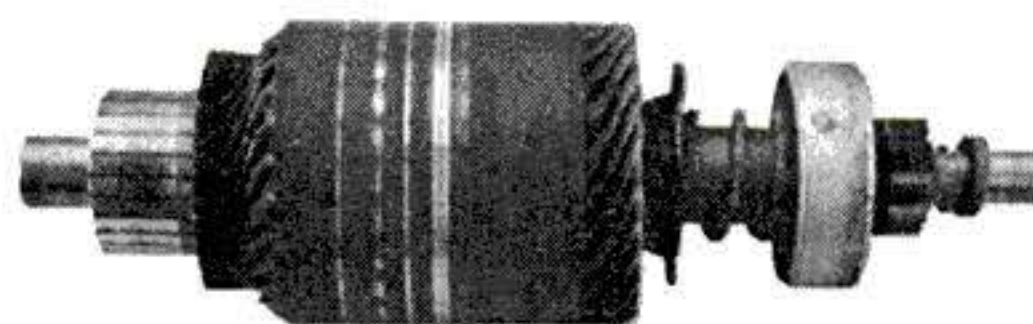
1 Problems inside the engine can put a load on the starting system that it can't handle. In this case, the cause is probably hydraulic or hydrostatic lock, caused by coolant seeping into the combustion chamber overnight through a leaky head gasket. When the piston rises on the compression stroke during cranking, the incompressible coolant stops the piston momentarily, until the coolant can leak past the rings.

Because it takes several hours for the coolant to trickle into the combustion chamber, the only start that is affected is the first one in the morning.

Fixing the leak can be easy or tough. First try a thorough draining and flushing of the cooling system to get rid of the old antifreeze, which has a tendency to "creep" through small voids. Then add an antileak preparation, without any antifreeze. If the antileak works, you can drain the system and add antifreeze.

If the antileak doesn't work, the only solution is to remove the cylinder head and replace the gasket. At the same time check for a cracked head. While the head is off, an automotive machine shop should check the head for warping, and resurface it if necessary. Also drain the oil and change the filter, because the oil may have become diluted.

2 He is pointing to marks on the side of the armature caused by its rubbing on the field pole shoes. The rubbing comes from worn bushings or bearings in each end of the starter. When the starter is try-



Armature rub marks usually cannot be seen as easily as those in this photo. But by looking carefully, you'd be able to spot them if they were present.

ing to crank the engine, the armature drags on the pole shoes and reduces cranking speed. Replacing the bushings or bearings is all that is necessary to fix it.



When a wing nut is corroded and a battery cable is worn this badly, clean the nut and replace the old cable. Don't give trouble a chance to happen.

3 If the current can't get out of the battery, and all connections are clean and tight, then the battery cable must be at fault. In this case, corrosion has probably eaten into the taped cable, gone inside the cable clamp and destroyed the bond between the cable and the clamp. The cable will look good after cleaning, but its conductivity will still be almost zero.

STARTING SYSTEM

By MILES SCHOFIELD

your engine's cranking speed begins to slow down.

So, on a Saturday morning you get out the baking soda and the garden hose to do a cleanup job. You even take the cable clamps off the battery posts and scrape them until their surfaces are bright and shiny. When it all goes back together, the top of the battery is as clean as a new car. Of course, the taped cable is still there, but you figure there's nothing wrong with that.

After all that work, the cranking speed is still slow, and getting slower. Even the headlights are affected, they're getting dimmer as the days go by. You obviously are not getting enough current. The battery is in excellent shape—practically brand-new—and all the connections are clean and tight.

What is the most likely cause of your continuing problem?

4 Sluggish cranking

Sluggish cranking rarely happens overnight. It usually occurs gradually, and by the time you notice it, the cranking is likely to be so slow the car will hardly start. When your

engine becomes a slowpoke at cranking, you do a thorough job of checking the battery, the starter, all the switches and solenoids, and the battery cables.

After all that, your engine still cranks much slower than it should. You hit the starter again, as you have several times in the last few minutes, and the slow grind of the engine is exasperating. Then, just by accident, you happen to touch one of the motor-mount bolts. It's warm, much warmer than any other metal near it. What does this mean, and where should you look for the cause of the slow cranking?

5 Engine starts and dies

You go out one ordinary morning expecting to be on your way to work with a turn of the key, but the engine dies as soon as you release the key to the run position. You try it several times, and you can hear the engine running in the second or two it takes to release the key from the start position. But the moment the key is released to the run position, the engine dies.

At first thought it seems as if

there is something wrong with the ignition switch. So you drive to work in your other car and pick up a new switch on the way home.

It's quite a chore getting the new switch into place, but you finally make it. You turn the new switch with great expectations. There is no change. The engine dies as soon as the switch is released. There is something in the electric circuit that allows the engine to run with the key in the start position, but not with it in the run position. You check your installation of the new switch and find it's okay. That rules out the ignition switch as a suspect.

You check the wiring diagram for your car and it shows two primary circuits supplying current to the coil, the normal circuit being from the ignition switch through a primary resistor, to the coil. The other circuit is only active during starting, and it bypasses the resistor to give full battery current to the coil.

It's obvious, after reading the wiring diagram, that the engine is running on the starting primary circuit, but not on the normal running circuit to the coil. Knowing this, where would you look for the cause of the trouble?

A condition like this can only be spotted by using a voltmeter in a voltage-drop test. With the meter on the lowest scale, one probe is placed on the battery post, and the other on the connecting post at the other end of the cable. While a friend turns the ignition key to crank the engine, you watch the voltmeter. Any reading over 2/10 volt is excessive, showing high resistance in the cable.

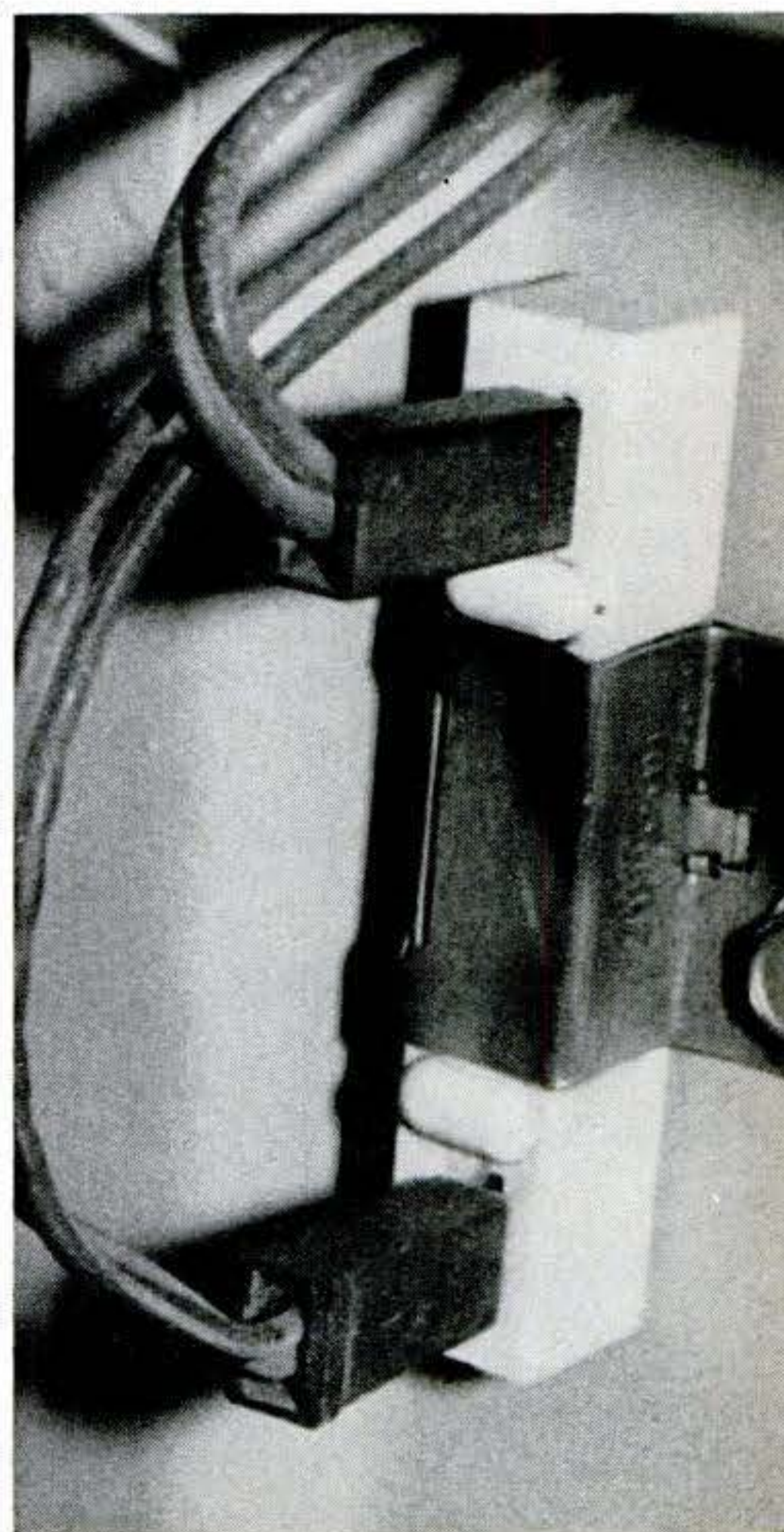
4 The current that runs the starting motor must return to the battery to complete the circuit. Usually, the motor mounts are rubber, with only a small contact area between the engine and the car frame, such as a lock washer or the shoulder of a bolt. To provide a good return path for the current, a ground strap is attached between the engine and the body or frame.

In this case the ground strap had worked loose, forcing the current to return to the battery through the motor mounts, which warmed the bolts. Cleaning the contact surfaces and tightening the strap will solve the problem.

5 The trouble is a burned-out primary resistor. Some cars have the resistor mounted in a porcelain block attached to the firewall. Others have a resistor wire built into the wire loom. The resistor cuts down the primary current going to the coil so the coil and distributor points won't burn up. During cranking, a bypass switch built into the starter, the ignition switch, or the solenoid sends full battery current to the coil for a hotter spark.

Replacing porcelain-mounted resistors is easy, because they simply unbolt and unplug. When the resistor in the wire loom burns out, the easiest way to fix it is to run a new resistance wire from the switch to the coil. Disconnect the old wire, tape the ends, and leave it in the loom. Caution: Don't use plain copper wire. Make sure it's a special resistance wire with the ohms-per-foot specified in the service manual. PS

A primary resistor of the porcelain variety is usually mounted somewhere in the engine compartment. Its wires are interchangeable—end for end.

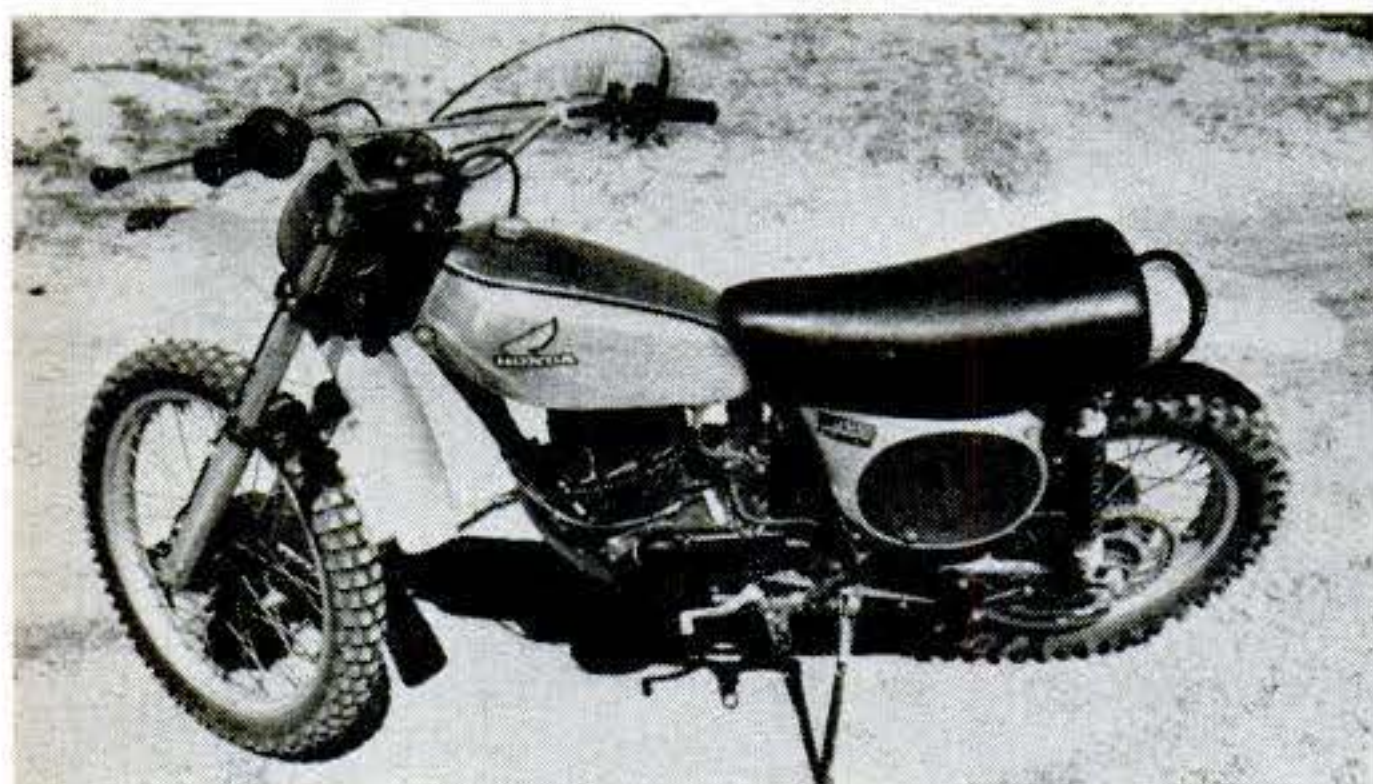


Honda's Elsinore 250:

A Potent Two-Stroke from the Four-Cycle King

By RAY HILL PHOTOS BY THE AUTHOR

Streamlined styling adds to Elsinore's appeal. Don't let the beauty fool you. This baby's tough.



Up in the air or on the ground, the 250 handles well. Lightweight bike is pleasingly sensitive to body english.

About five out of every 10 motorcycles sold in the U.S. are Hondas. And now Honda plans to grab a large chunk of a new market—the thousands of off-road riders who enjoy motocross competition. For that, they've introduced a totally new machine, the Elsinore 250. I test-rode the hot new bike recently.

The first thing I noticed when I twisted the throttle was that the front wheel was two feet in the air. Yep, doing a wheelie with the Elsinore is as easy as falling off a log. That's partly because the machine is the lightest production motocrosser in its displacement category (214 pounds dry), and because of the

powerful 248cc engine that boots it.

Although bringing the front wheel up easily isn't usually desirable for street riding, for motocross it is: to clear obstacles more easily and to give greater traction to the rear wheel.

Handling is superb. Brakes are excellent, much better than those often found on motocross machines. The two-cycle engine? Well, it's painted black for better heat dissipation, and it accelerates like a bat.

The gear ratios of the five-speed constant-mesh transmission are evenly spaced. This, combined with the bike's light weight and strong power plant, means you'll be able to con-

Heavy-duty front forks are long-traveling to help absorb the bumps. Front and back fenders are made of tough plastic to decrease the weight.

Finned reservoir on each rear shock helps to dissipate heat from the shock fluid. These shocks are easily refillable for quick maintenance.

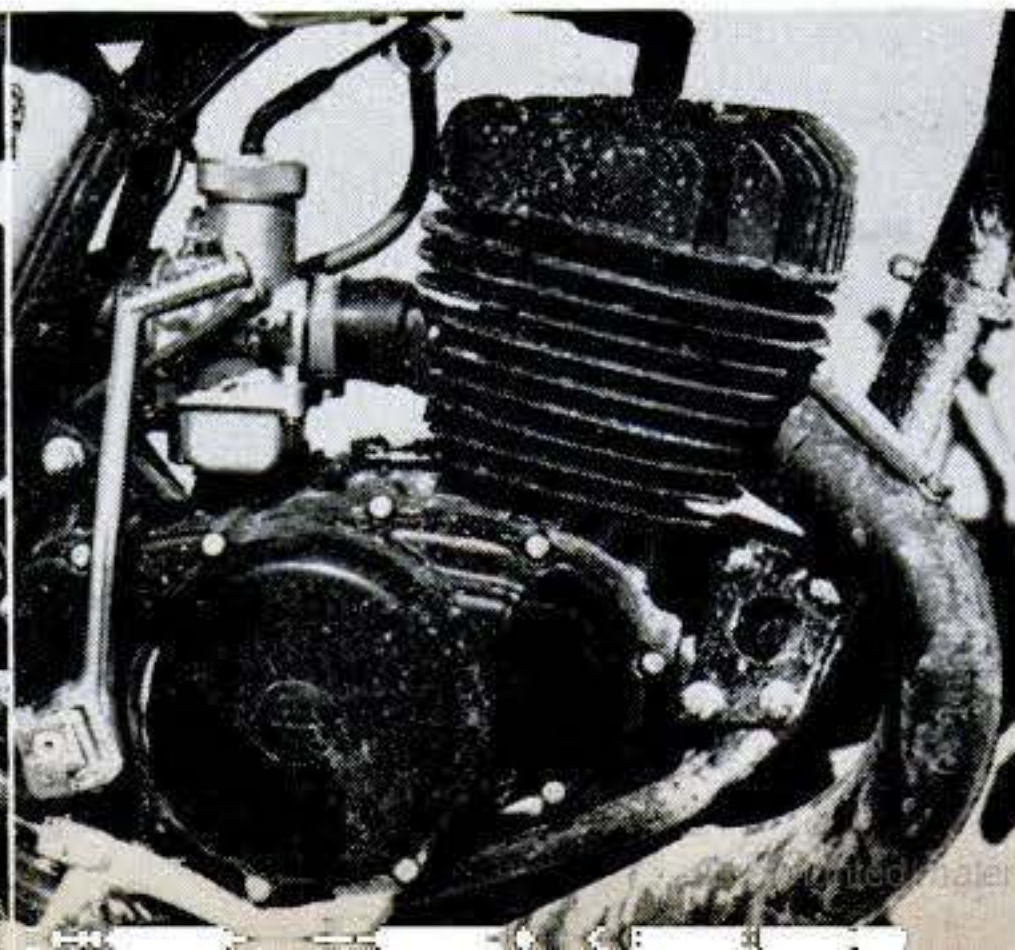
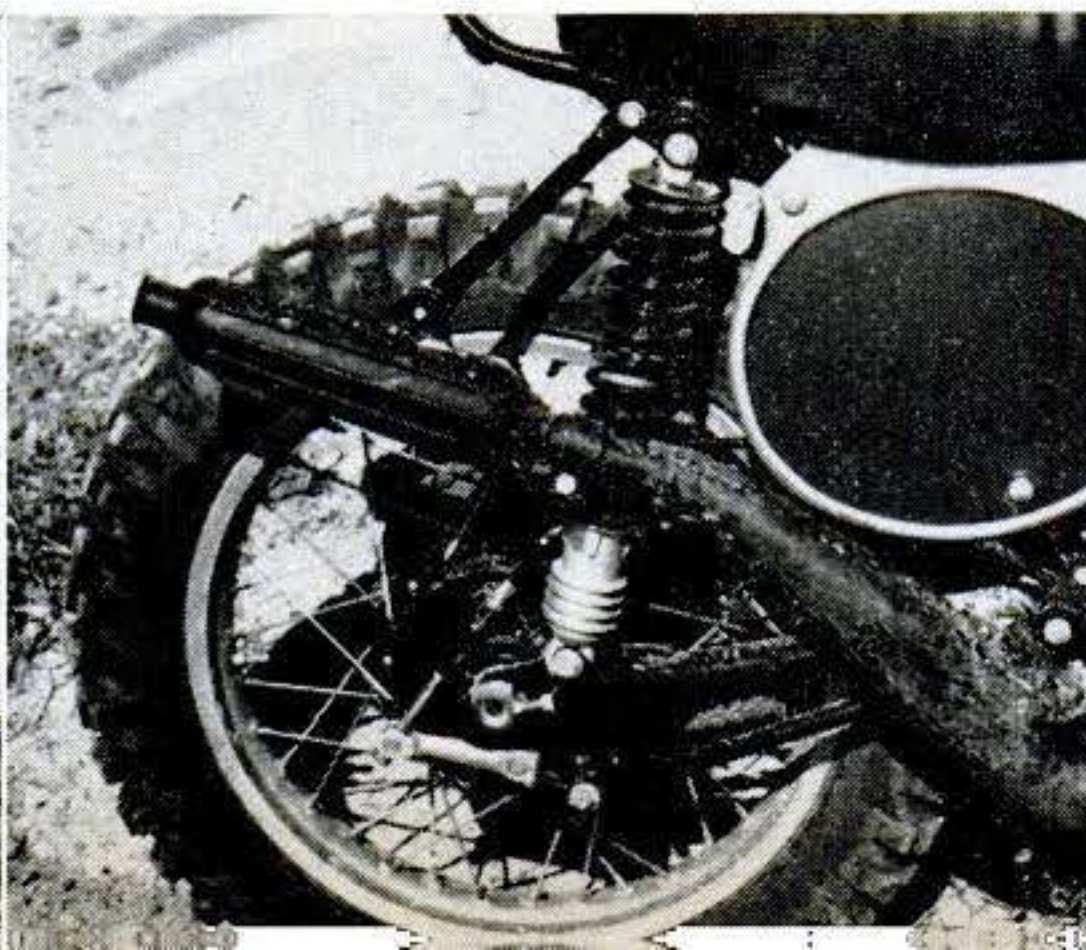
EL SINORE 250 SPECS

Engine	2-stroke, single-cylinder
Displacement	248cc
Bore and stroke	70mm x 64.4mm
Transmission	5-speed constant mesh
Clutch	Wet, multiplate
Brakes	Internal expanding shoe
Suspension	Front: telescopic fork Rear: swing arm
Tire size	Front: 3.00-21, rear: 4.00-18
Ignition system	Flywheel magneto
Starting system	Kick
Wheelbase	57.1 in.
Dry weight	214 lbs.
Overall length	84.3 in.
Overall width	35 in.
Seat height	32.7 in.
Fuel capacity	1.8 gal.
Color	Metallic silver

quer just about any terrain you encounter.

The Elsinore 250 is an excellent motocrosser. My only complaint is that the engine's power band is a little narrow. I had to keep the rpm up for optimum performance. If you're in the market for a motocross machine, look at this one. **P 5**

Honda's first two-cycle engine is an excellent performer. Quick starts and rapid acceleration are prime characteristics of the power plant.



One of these will make a Browning Man out of you

Our records show that more than half of the people who buy a Browning shotgun, buy it because they own or have used a Browning gun before. In the case of the Browning Automatic-5 the figure is 58%. For the Browning Superposed the figure is 72%! (These figures are from our 1972 survey.)

That says a Browning speaks for itself. Once you shoot one and see one in action, you want one. After you buy one, you find yourself buying another. Most Brownings aren't sold in a store. They're sold in a duck blind or in a corn field.

All of this is a pretty intelligent reason for you to buy your first Browning.

Consider the Automatic-5. The first shell you thumb into the magazine is instantly whisked to the chamber. When you work the action, you get that smooth, solid operation that comes only from machined, properly heat-treated steel. Its sharp sighting plane makes it easy to "hit" with this gun. The Auto-5 is a "shooting machine" that never gets out of tune. It's a gun you'll never part with.

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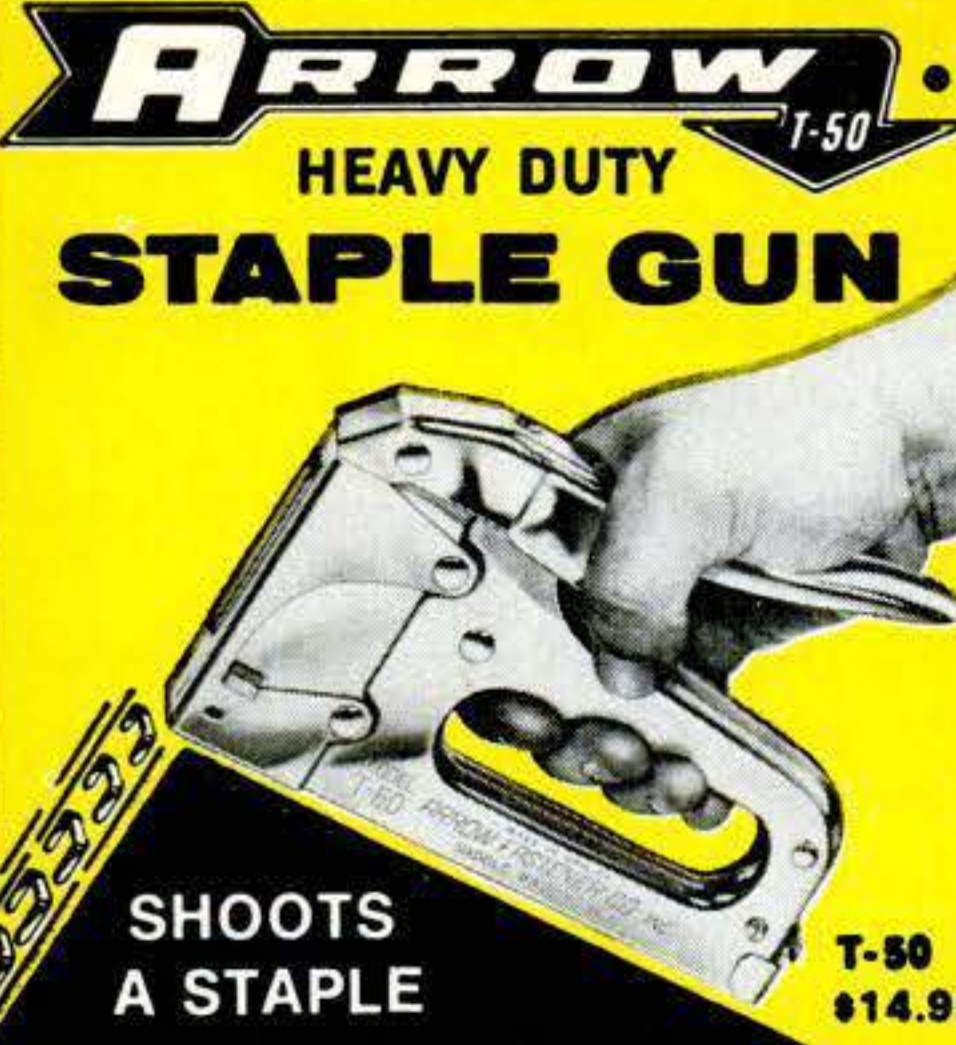
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 3/8" STAPLE for fastening light insulation, roofing papers, electrical wires, weatherstripping, wire mesh, etc.	 1/2" STAPLE for tacking underlayments for carpets, porch screening, felt stripping, canvas, fiberglass, etc.
 9/16" STAPLE for tacking metal lathing, cornerite, wire fencing, roof coverings, insulation board, etc.	 CEIL TILE staple - especially made for safe, secure installation of ceiling tile.

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Atomic Energy Safety

[Continued from page 81]

But there have been more specific incidents that brought the AEC into action. Take the incident of the misplaced steam lines, which started with an anonymous letter telling the AEC that the Northern States Power Company's incomplete Prairie Island plant in Minnesota had a steam line running through a building that contained safety equipment and also under the control room; a break in the line at those points could knock out equipment and operators. Following up the lead, AEC found the same situation in several other reactors. Eventually, AEC asked those utilities to prove that safety-equipment buildings were protected against such accidents.

And then there is the whole issue of valves. Every nuclear plant contains between 600 and 1000 valves, and the performance record is far from perfect. According to a 1972 AEC report, faulty valves caused approximately one coolant release incident (albeit minor ones) for each two reactor-years of operation.

Perhaps the most extensive test of AEC's quality-assurance program involves valves. It began in 1970, when an AEC inspector asked a utility for the documents attesting to the quality of several valves. The utility found it didn't have some documents, and that the documents that were available indicated that some valves were not up to specification thickness. Eventually, AEC learned that the required documentation was missing for 10-20 percent of *all* valves in nuclear plants. A following program resulted in most licensees' correcting the situation.

To James Henderson, chief of AEC's construction branch, and other AEC regulatory officials, the valve incident shows that the regulatory program works. They point out that the AEC discovered the flaw, followed it up, and got action. Says Daniel F. Ford, a Harvard economist who is one of the driving forces in the Union of Concerned Scientists, their prime concern nuclear safety: "One wonders how these plants could have been licensed. One thing required for licensing is documentation that the plant meets quality assurance standards. But these documents just didn't exist. It shows a major breakdown in the quality-assurance program that is the AEC's primary assurance of reactor safety."

Tangled as it is, the debate over the quality-assurance program covers only the possibility that the emergency core-cooling system will be needed. The question of the ECCS's

ability to perform adequately if it is called upon is something else—a long, even more tangled issue with a history that shows the AEC at its most vulnerable.

The ECCS question began to heat up as early as 1965, when utilities first presented proposals for building large, 1000-megawatt nuclear generating plants. Concerned about the emergency system designed for these plants—systems that everyone now agrees were more or less tacked on as an afterthought—the AEC appointed an expert committee to study the subject. The committee reported in 1967 that the effectiveness of the safety systems was far from assured, and that a lot more work needed to be done.

AEC told Oak Ridge National Laboratory to start some studies, and industry was given some contracts to conduct tests and to run computer models of ECCS operation.

The closest thing proposed to a true test of an ECCS is a facility called LOFT (for "loss of fluid test") at the National Reactor Testing Station in Idaho. LOFT originally was scheduled to go operational in 1966, but a lack of funds and insistence that it be built to the highest standards has held back this 1/50 scale reactor distressingly. The first LOCA tests will not begin until next year, and significant data will not emerge until 1975.

Meanwhile, AEC and industry safety researchers have used computer models and small-scale tests. Results have not been happy. Perhaps the most disturbing event occurred in the fall of 1970, when the Aerojet Nuclear Company, a major safety contractor, ran a series of tests on a tiny, nine-inch-diameter model reactor core to study various aspects of coolant loss. In that test, the company reported, "essentially no emergency core coolant reached the core;" the injected water simply ran out of the break in the coolant pipe.

Whether this simulation was necessarily realistic is questioned in several quarters.

Meanwhile, rumbles of dissatisfaction about the safety program were coming from the AEC's own staff and contractors to the commission's headquarters in Germantown. In a series of memorandums and reports, the men in the field were telling the higher-ups about their deep unhappiness with the nature and results of the safety program.

For example, in December 1971, William B. Cottrell, director of nu-

Continued

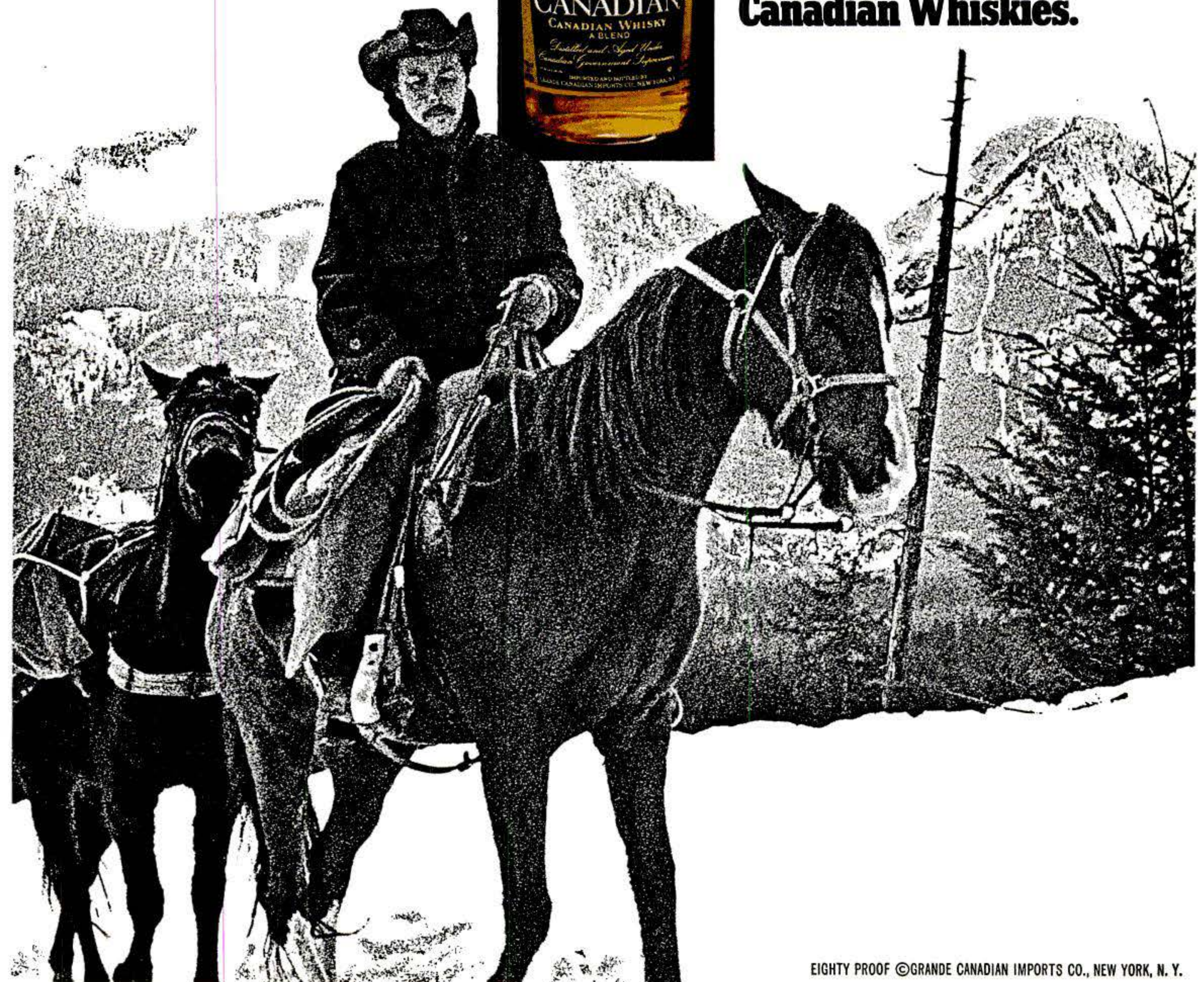
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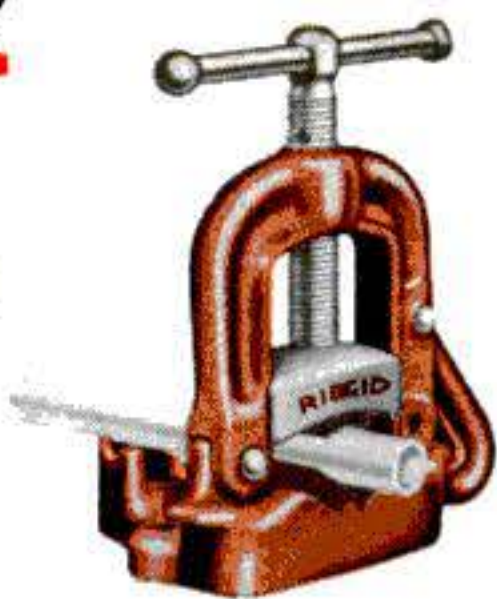
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Atomic Energy Safety

[Continued]

clear safety programs at Oak Ridge, and other researchers there, wrote headquarters a letter saying that there were "wide gaps in our knowledge." Earlier, Morris Rosen and Robert J. Colmar, two experts on the regulatory staff, had analyzed a Westinghouse computer model named SATAN, which predicted the ECCS would work, and had identified several errors, and called the overall justification of the model into question.

In late 1970, the AEC appointed a task force under Stephen H. Hanauer, highly regarded as a safety expert, to set standards for emergency core-cooling systems. After the Hanauer committee reported back to the AEC, the commission in June, 1971 proposed "interim criteria" for ECCS's. Their most significant requirement was that an ECCS limit maximum fuel cladding temperature at the hottest spot of the core during a LOCA to 2300 degrees F (the utilities had been asking limits as high as 2700 degrees). Among other things, the interim criteria took into account the small-scale LOCA test's results, specifying that the requirements had to be met under the assumption that much of the water injected by the low-pressure ECCS never reached the core.

All of this was only a prelude for what turned out to be a crucial event: hearings by the AEC to set uniform standards for emergency core-cooling systems. The hearings were called because the AEC had been hearing evidence on ECCS plant by plant; the idea was to get the whole thing over with at once. What ensued was an incredibly long, occasionally rambling, sometimes dramatic series of sessions, running for 122 days and to 22,000 pages of testimony, that began in February, 1972 and still have not formally ended.

The critics' case was largely carried by Consolidated National Intervenor, an organization representing 58 opposition groups, with a lawyer named Myron Cherry and Daniel Ford, the economist, carrying the ball, and an MIT physicist, Henry W. Kendall, providing the bulk of technical criticism.

The result of the hearings so far hardly seemed dramatic: AEC proposed new interim ECCS standards lowering the allowable maximum temperature during a LOCA to 2200 degrees F and adding new restrictions on such things as cladding oxidation and hydrogen generation.

However, the critics are far from

satisfied. In May, Ralph Nader sued AEC to close down 20 nuclear power plants on the grounds that they were licensed under the old interim criteria. The suit was dismissed on the basis that AEC's procedures for challenging safety of nuclear plants had not yet been exhausted.

But there are now several indications that AEC is getting tougher.

Last May, the commission fined the Virginia Electric and Power Company \$40,000 for alleged violations of safety regulations at the company's Surry nuclear plant—the first fine ever imposed on a utility for nuclear-plant safety infractions.

That same month, Dixy Lee Ray, the tough-minded marine biologist who is AEC's new chairman, staged what amounted to a *coup d'état* when she forced through a vote taking reactor-safety research out of the Division of Reactor Development and Technology. That move met a long-standing complaint of critics, who pointed out that the division was charged both with promoting nuclear energy and with overseeing the safety program—something the critics said was equivalent to having the father of a Little League ballplayer serve as home-plate umpire. Safety now has its own AEC division, headed by Herbert C. Kouts, a man with long experience in reactor safety.

But there still is no final, definitive study on the probability of failure of a modern, large-scale nuclear power plant, and of the damage to property and life that such a failure might cause. With utilities pressing to locate nuclear generators near populated areas, that gap is highly significant. Decisions on siting plants hinge on knowledge of how much damage an accident will cause, and how far that damage will extend. A study to answer those questions is being performed by Norman Rasmussen, a nuclear engineer at MIT, for AEC.

What is the chance of a major accident that would release large amounts of radioactivity? The AEC estimates that such an accident will happen once in 100 billion reactor-years. A University of California study commissioned by that state estimates the chances at one in 100 million reactor-years. The critics estimate the chances to be much higher—well within probability.

The key word in all these sentences is *estimates*. No one will really *know* how huge reactors behave until several thousand reactor-years of experience are accumulated. **PS**

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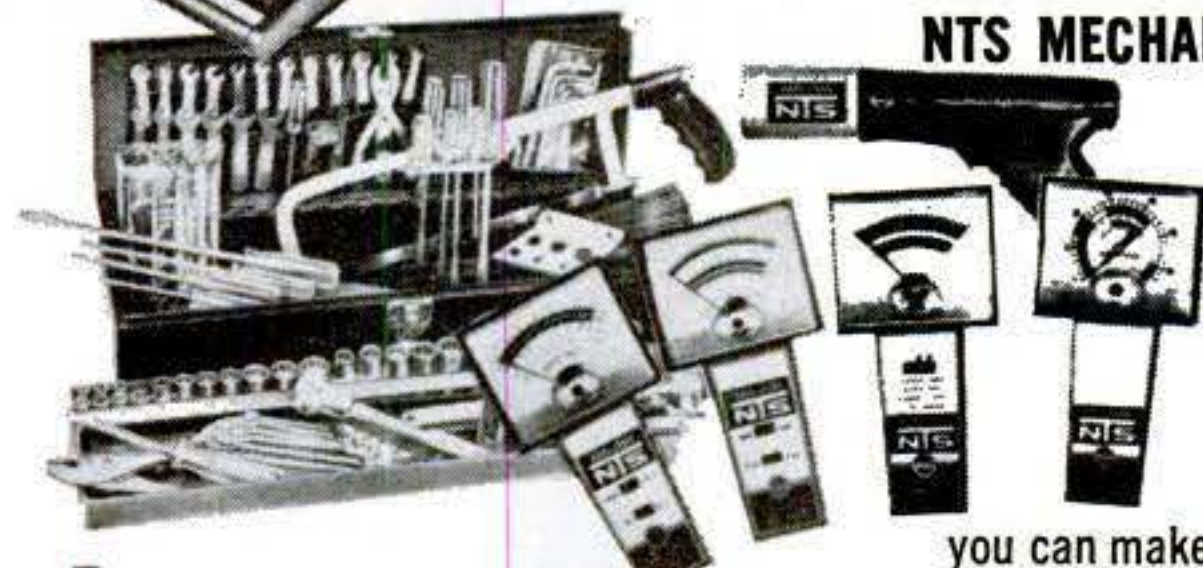
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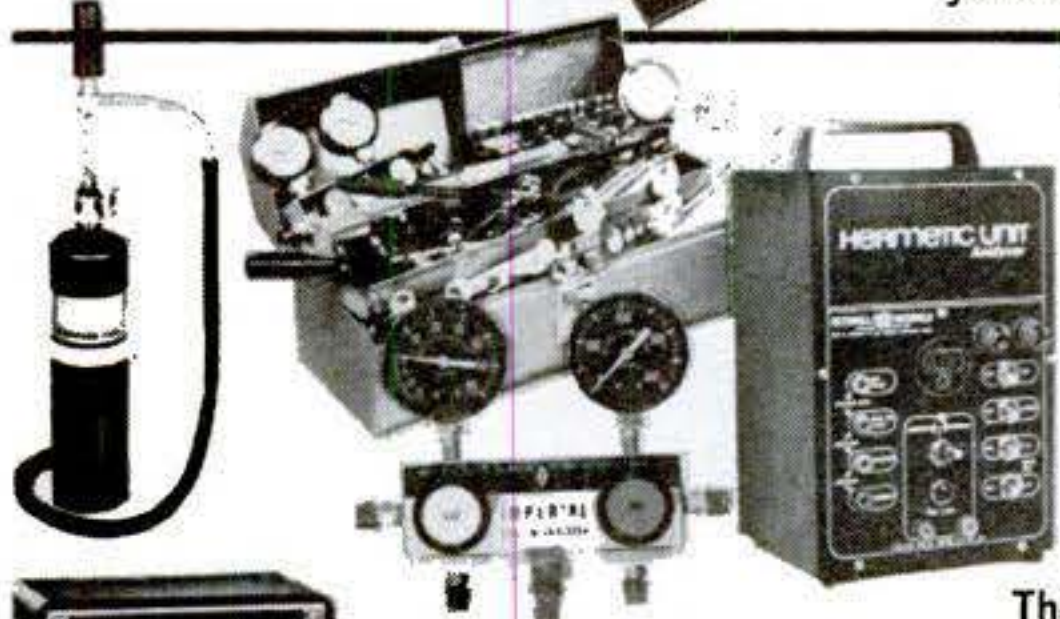
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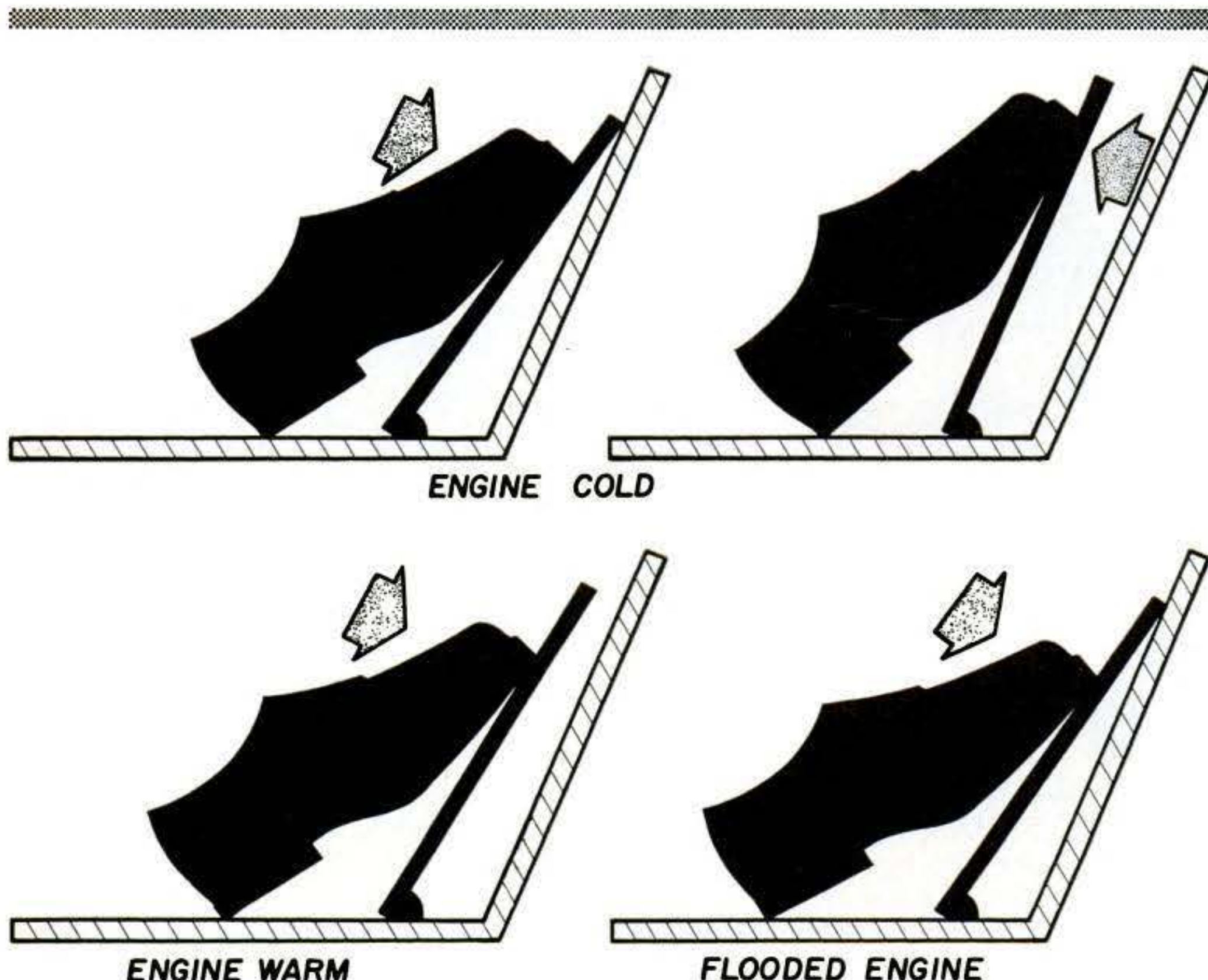
Taking Care of Your Car

By RAY HILL

Good hints others have used

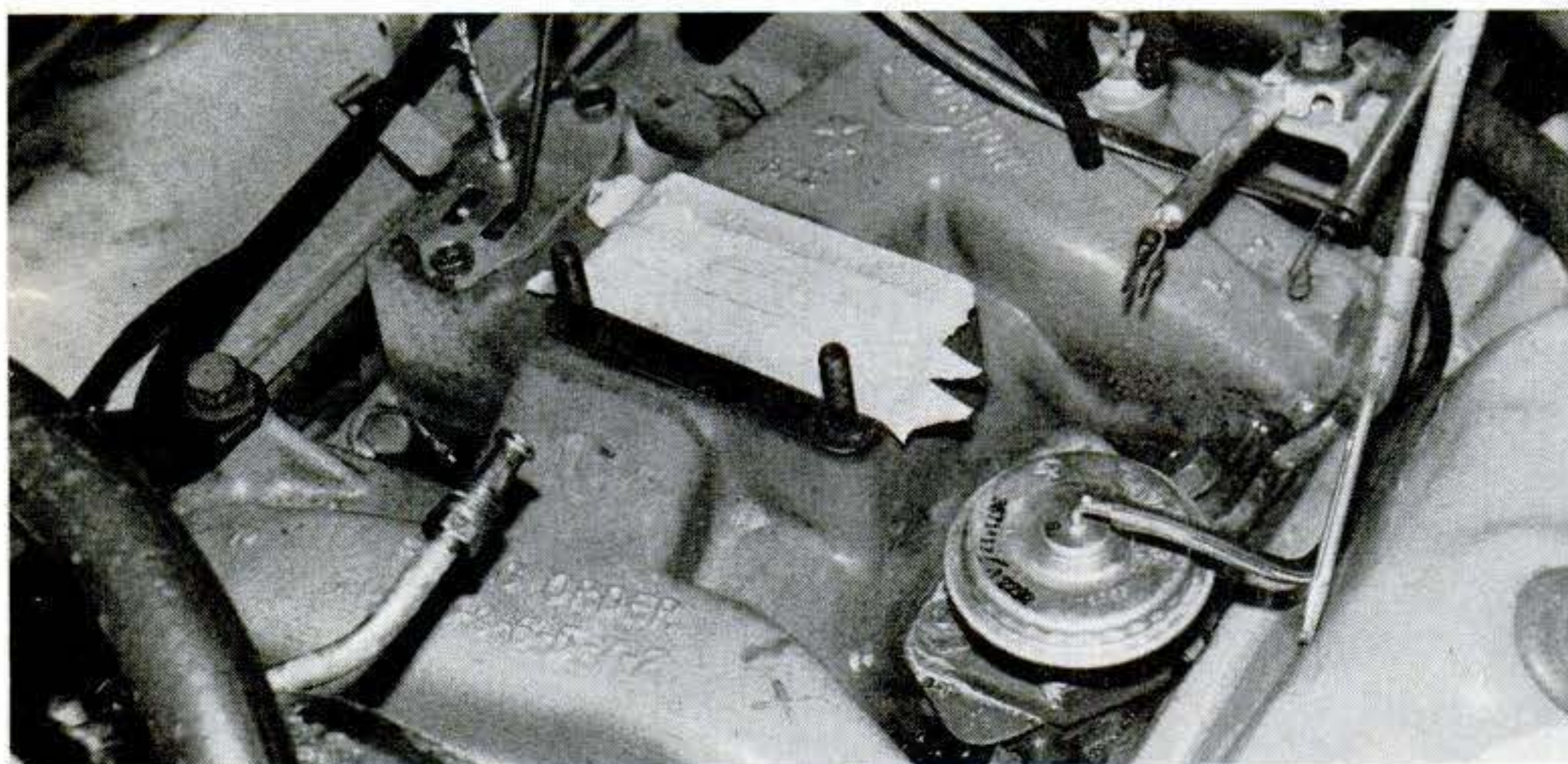
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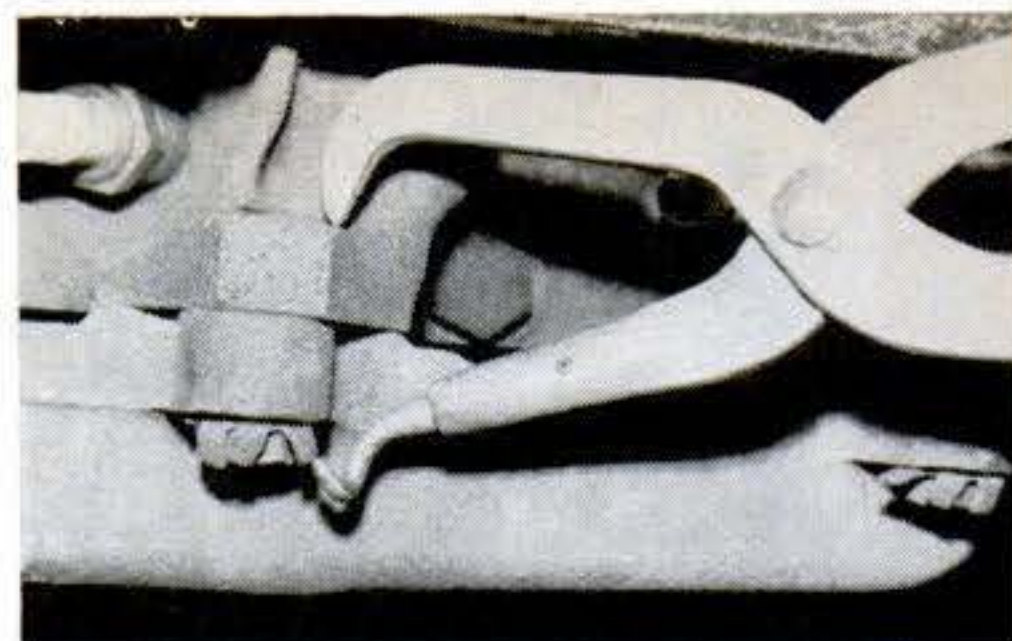
Starting sensitive cars with emission controls

Cold engine: Depress the accelerator pedal to the floor and release it. Then turn the ignition key to the start position. After the engine has run about five seconds, tap the accelerator pedal to reduce idle speed, and place the transmission in gear. Avoid rapid or wide-open acceleration until the engine is warm. **Warm engine:** Hold the accelerator part way down while starting. **Flooded engine:** Depress the pedal fully until the engine starts.



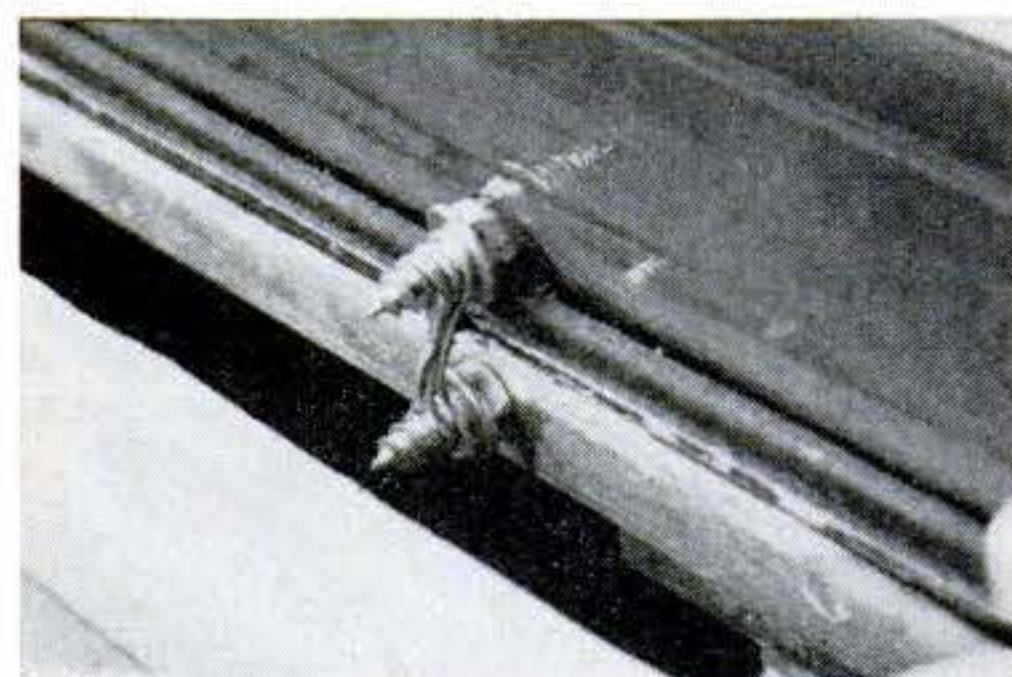
Removing carburetor from the intake manifold

If the carb will be off for very long, it's a good idea to cover the exposed manifold holes with masking tape. This will prevent loose parts dropped accidentally from finding their way into the combustion chambers.



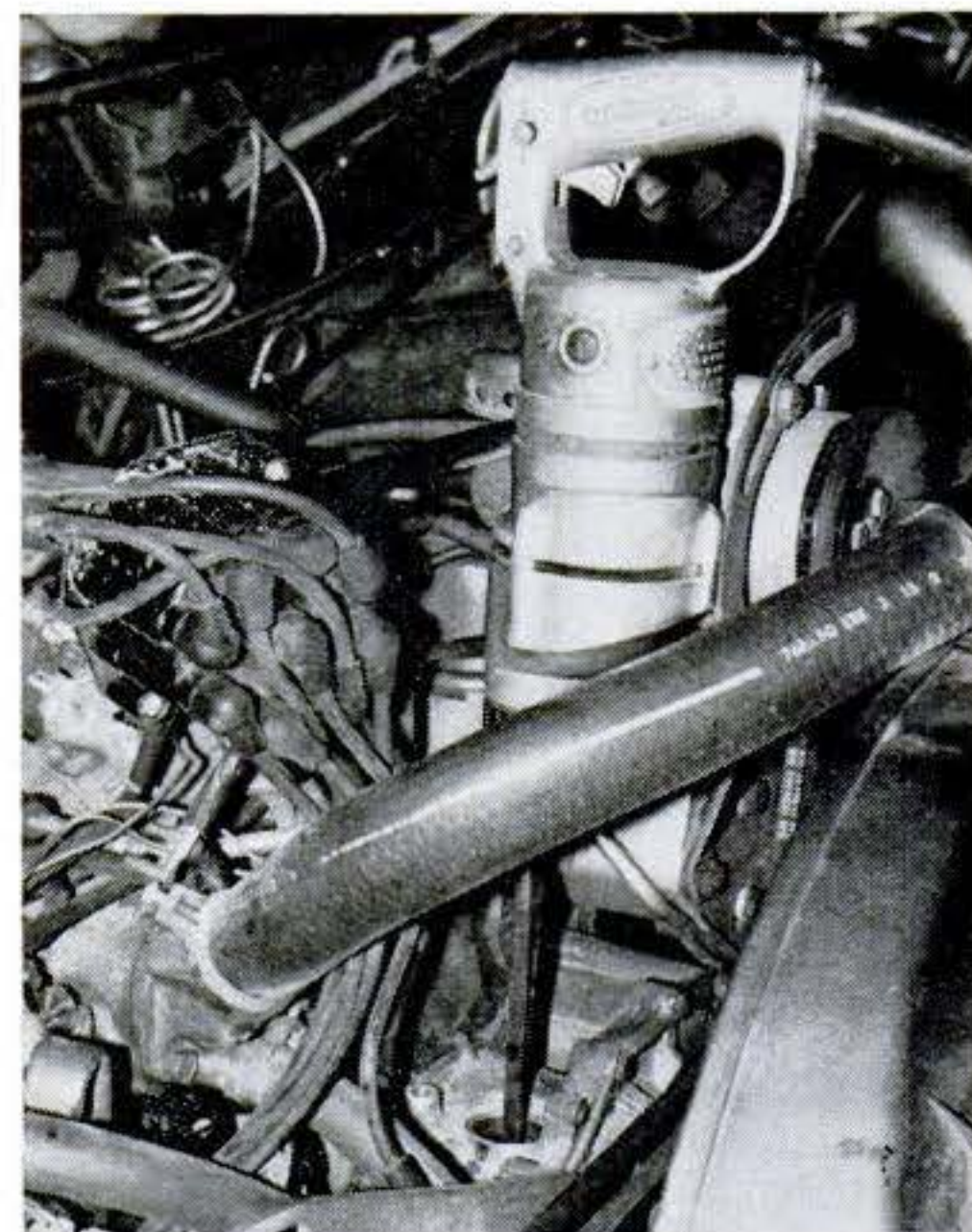
Removing manifold bolts

Some cars have locking clips on the exhaust manifold bolts. They are often difficult to bend up to get a socket on the bolt. A pair of brake-spring pliers with long handles permits easy release of the clips. Just place the pliers as shown in the photo and squeeze.



Fixing loose windows

In many cars, when a window glass becomes loose it binds. With epoxy cement attach a screwhead to both the glass and the window support. Secure the glass by tightening a few turns of wire around the two screwheads. Now the window is tight again and should stop binding.



Building up oil pressure

When starting an engine after an overhaul, oil pressure must build up fast to protect dry, tight wearing surfaces. To prime the oil pump before starting the engine, it's a good idea to use a screwdriver blade in a drill to turn the oil-pump shaft until the oil gauge shows pressure.

TOO MANY CHEFS CAN SPOIL YOUR OIL.

It seems as if everybody has something for you to add to your crankcase these days.

For some reason people think the more additives you put into your car's crankcase, the more you'll get out of your car. The fact is, it could work out just the opposite.

Some additives may thicken the oil to the point that it becomes harmful. Especially in cold weather when thickened oil can lead to increased engine wear.

Also, when the electrolyte fluid in your battery is cold, its output is lower. That, with hard cranking because of thickened oil, can cause hard starting, which puts a strain on your battery.

In addition additives don't remove contaminants. Only an oil change will remove contaminants.

The truth is you don't need supplemental additives. All they can do is cost money. If you want your engine to run well, don't add things to your crankcase. Put in a good quality motor oil to begin with, and change your oil according to the auto manufacturer's recommendations, and you'll be giving it all it needs. Because a good oil already has special additives in it. The same type that some people try to make you pay extra for.

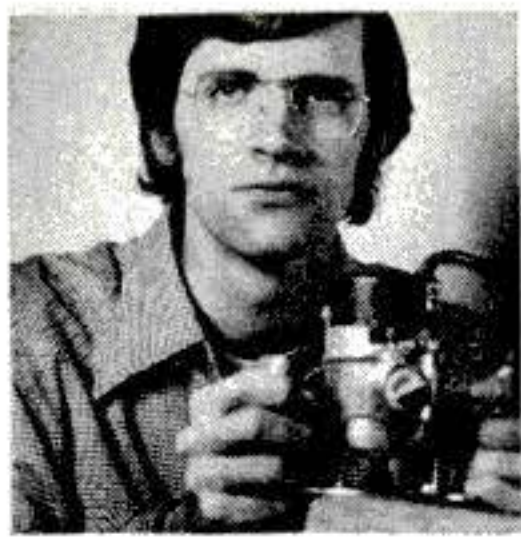
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Shop Talk

News and view of tools and materials
By A. J. HAND

Brickbats for the old brick-in-the-toilet trick

A while back, the town of Cherry Hill, N. J., purchased an order of 34,000 bricks. Their plan? Distribute the bricks to citizens for placement in toilet tanks. The idea was to save water. In theory, each brick would save its volume in water through displacement each time its toilet is flushed. Cherry Hill figured the plan would save 34,000,000 gallons a year. Unfortunately, the trick doesn't work.

How come? As the Chairman of the Assn. of Industry Manufacturers (Plumbing-Cooling-Heating-Piping) explains it: "This theory ignores the actual operation of the tank. When the toilet is flushed, the tank ball or stopper reseats and stops the flushing action with two to three inches of water remaining. This water will keep a horizontally-placed brick continuously submerged. In order to displace water which actually flushes, any object placed in the tank must be above the minimum drainage level. Thus, the horizontally-placed brick will do no good at all."

If you want to save water, try this: Bend the float ball arm down about two inches. Tests have shown this won't affect flushing efficiency. It will save the average family over 20 gallons of water a day. And it doesn't even cost you the price of a brick.

Don't get stuck on glue

Everybody likes the way epoxy glue sticks things together. But who likes paying a buck or more for those little twin-tube put-ups you see just about everywhere these days? Certainly not the folks at Connecticut's Mystic Seaport. They use a lot of epoxy in their boatbuilding shop, and can't afford to pay the 1000-percent markup that's common on blistercard packaging.

Their solution? They buy their glue in quantity. The resin—Shell's Epon 828—comes in five-gallon cans. So does the hardener—Versamid 140. Any medium-high viscosity resin (10,000 to 15,000 cps is about the right viscosity) will do the job.

Where can you get the stuff? Mystic recommends three sources:

- Allied Resin Corp., East Weymouth, Mass., 02189. They have a catalog that includes valuable information.

- Miller-Stephenson Chemical Co., Box 623, Danbury, Conn. 06810. They carry Shell and a general line of related products, and provide spec sheets and price lists.

- Chem Tech, 4481 Greenwold Rd., Cleveland, Ohio 44121. They specialize in high-grade epoxy formulas for boat work.

Break in that new saw chain

Have a new chain saw, or a new chain for your old saw? You can ruin that chain in five minutes if you don't break it in right. Omark Industries, makers of Oregon cutting chains, offers the following advice for break-in:

Soak the chain in oil before you

put it on the saw. Then put it on the bar and tension it properly, following the instructions that come with the chain, or those in your operator's manual. Next, start the saw and let the chain run slowly around the bar a little above idle speed. This gives the chain parts a chance to line up with bar groove and drive sprocket.

Make a few easy cuts at half throttle, oiling the chain liberally as you cut. Stop the saw and let it cool. Re-tension, re-oil, and resume cutting, gradually working up to high speed.

High-speed paint roller

Painting my new attic bedroom and bathroom (see the feature article) proved a lot simpler than past painting chores. Why? I used a new type of roller called Speed Painter. It's shown in cutaway at right. Two things make it unique: That built-in

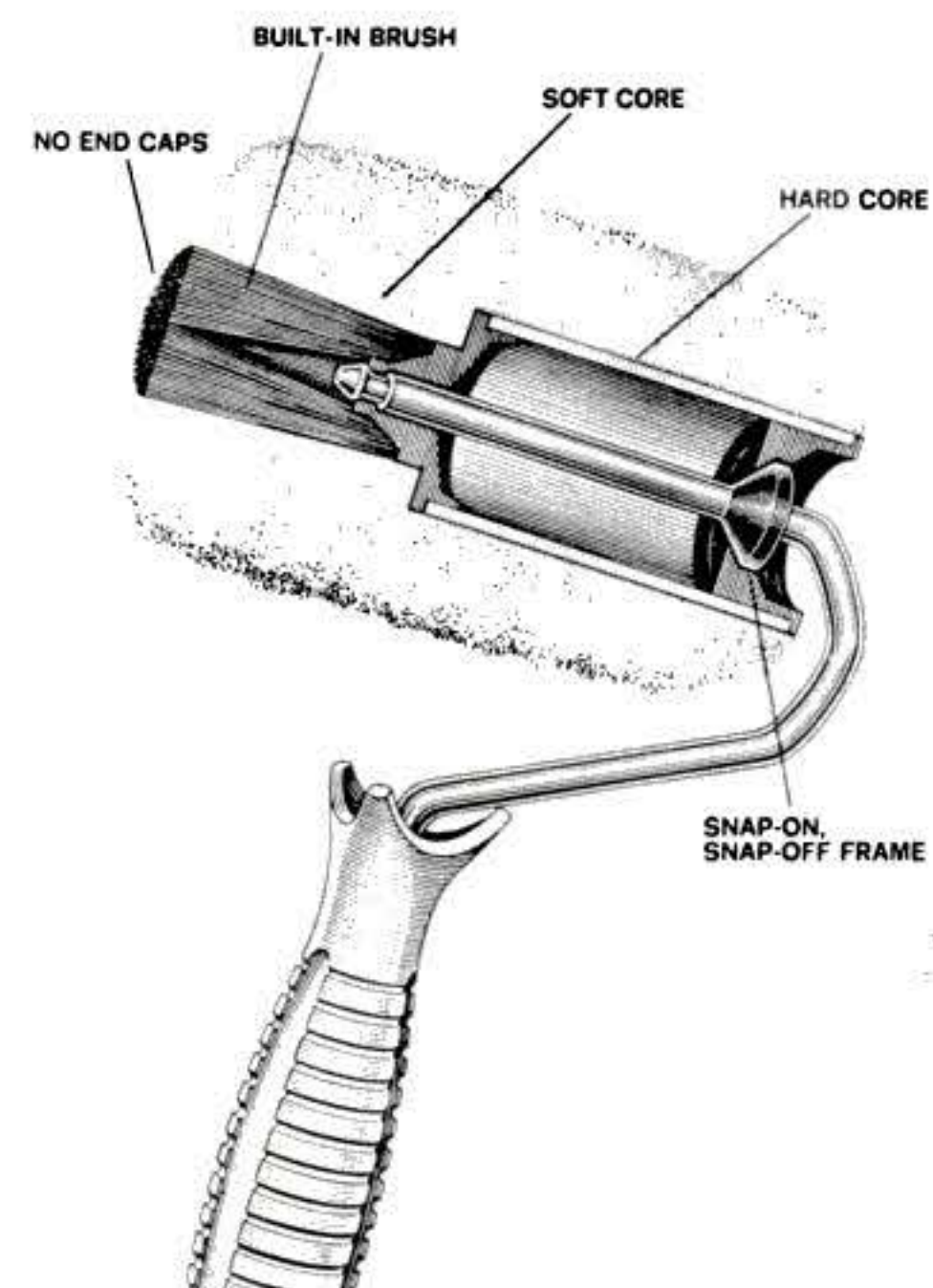
brush, and the soft, flexible core. Those two features combine to make Speed Painter live up to its name.

For example: You can use the built-in brush to cut in corners. On a wall job you just press the bristles into a corner and stroke the paint on as you would with an ordinary brush. Then roll over the paint to give it a roller-applied texture like the rest of the wall. The brush came in handy on my V board paneling, too. There it put paint all the way into the V grooves between boards. One wipe per groove did the trick. Then a follow-up stroke in the roller mode removed the brush marks.

The soft body? It conforms to moldings, trim, pipe, etc. And it's tough. Even after repeated washing the roller was still in good shape. One other thing: Since the roller has no end caps, you can dip it right into the paint can if you like, dispensing with roller trays.

I didn't try it, but I'd bet you could paint your house—clapboards, shingles, you name it—with this roller. What *won't* it do? Well, the brush won't cut a clean line. So if your walls are one color, and your ceiling another, you'll have to cut in the borders with an ordinary paintbrush.

Who makes it? Rollers by Baker, Brandon, Vt. 05733.



things to write for

- A booklet called "Lost Wax Steam Casting" tells how to cast sterling silver jewelry. You could use the same techniques and tools to cast small parts out of other metals. It's \$1.50 from California Crafts Supply, 1096 N. Main St., Orange, Calif. 92776.

- A series of "Project Knowledge" booklets by Stanley Tools. Six booklets describe how to: 1.) Install door locks. 2.) Install wall switches. 3.) Counter-sink nails, screws. 4.) Panel a room. 5.) Prune roses, shrubs, evergreens. 6.) Use Surform tools. A dime each from the Stanley Works, Box 1800, New Britain, Conn. 06050.

- A series of booklets on how to make molds and cast plastics. Includes information on making rubber molds, casting plastic in simulated ivory, marble, bronze, aluminum, brass, copper, etc. Free from Adhesive Products Corp., 1660 Boone Ave., Bronx, N.Y. 10460.

Wireless Switch

[Continued from page 99]

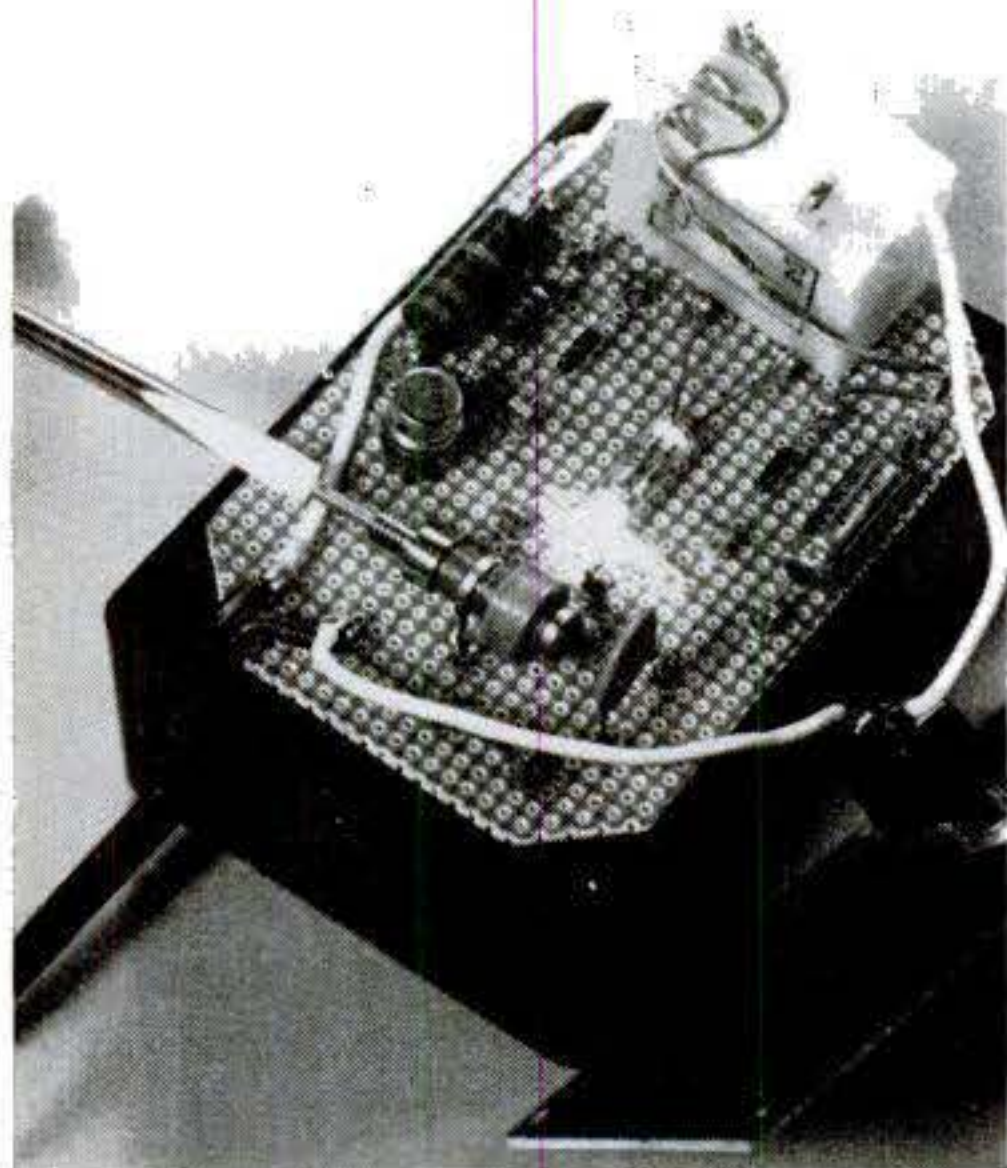
push the button on the transmitter for the receiver you are tuning. Carefully tune (watch out for line voltage on the board) the coil L for a strong glow of the neon bulb each time you push the transmitter button. Adjust the coil for the strongest light when only that number is pushed on the transmitter.

Since this is done with the box open, the relay may or may not operate. Once the receiver is placed permanently in its container, however (and outside light can no longer strike the photoresistor), you should hear the relay click.

Other ideas. Since the system uses the AC line for its connection, you can share it with your neighbor. When you're away, he can control your indoor lighting to confuse thieves, and actuate outside lighting for checking your yard.

Power-line transformers, however, will block signal transmission, so you may be restricted as to which neighbor you can use. In your home too, a second phase from the power line may mean adding a 0.1 mfd @ 400-volt capacitor between the two hot lines coming into your home to operate the switch from all areas of the house. Try the switch first, however; you may not need it at all.

You can build extra receivers, all tuned to the same button—for multiple lighting, say. Push one button on the transmitter and entire lighting schemes all over your home come on. And, extra transmitters can save steps and make appliance control convenient from anywhere in the house. No matter how many of each you build, the wiring remains the same—you just plug them in. **PS**



Tune receiver until neon bulb glows when one button on transmitter is intermittently pressed. Relay may not actuate.

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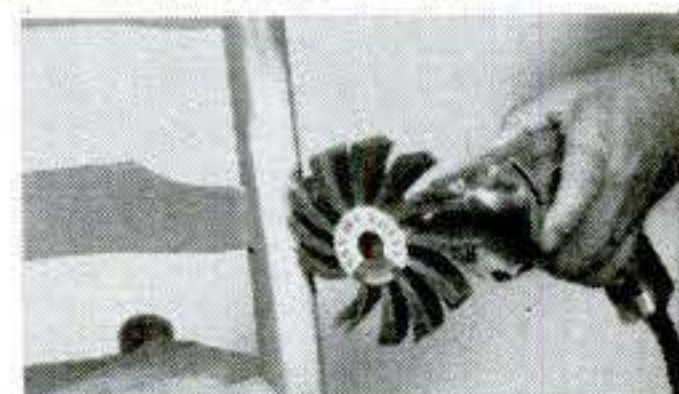
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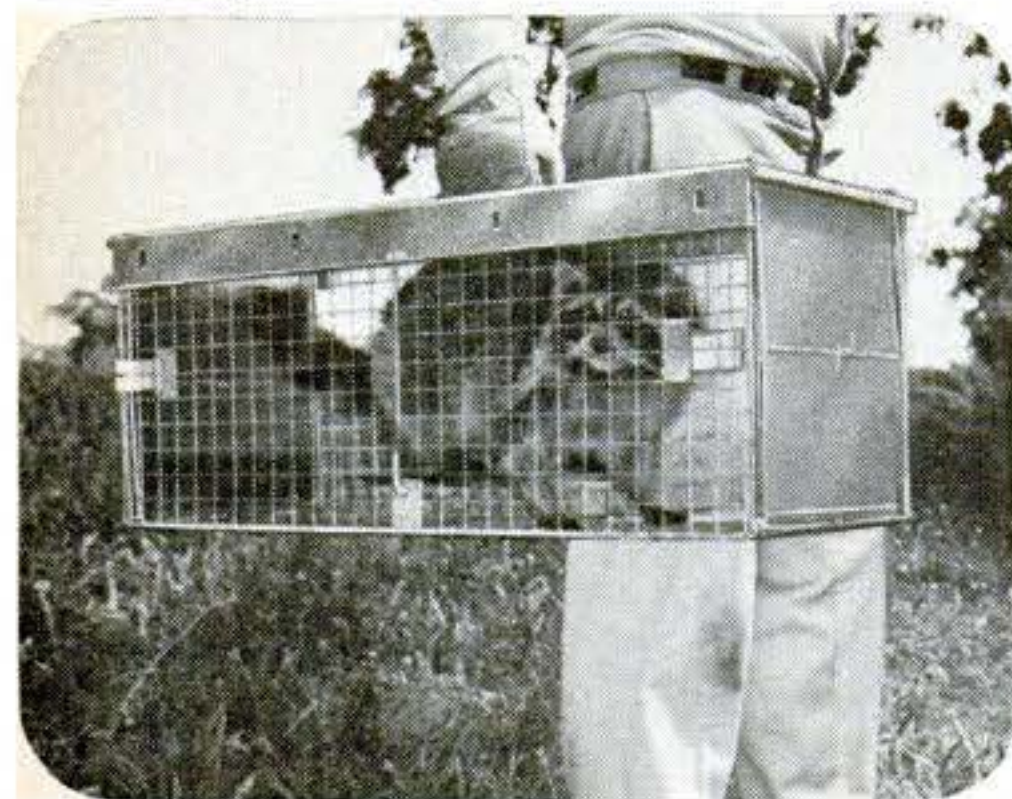
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Tornado!

[Continued from page 66]

annually, but only 1.5 percent of them account for 85 percent of the havoc.

Unanswered questions. In the past few years meteorologists pretty well established the general conditions needed to produce tornadoes. But what nobody knows right now is what specifically causes the air to whirl so fast, and what really happens in the tornado's center. What is the wind inflow angle? What are the temperatures and air pressures at various distances? In fact, what is the wind speed? And how can you tell when a tornado is about to be born?

One reason such questions remain is that tornadoes are so small and short-lived, qualified observers are seldom present. And in the few instances when instruments were in the path, they blew away.

"We're in the position in severe-storm meteorology that medicine was in when the circulation of the blood was discovered," says Dr. Kessler. "They knew that the blood circulates, but none of the details of the channels."

Slowly, the lab is finding answers, though, and each new storm that passes within the 100-mile range of its sophisticated new instruments drops a few more hints.

The twister that leveled Union City, for example, is typical, though larger and more destructive than most. It really started in the Gulf of Mexico, when warm masses of moisture-laden air moved up across the flatland of Texas, becoming even warmer from the hot sand. Meantime, other winds were blowing across the Rocky Mountains.

Dry, cool winds. Part of this flow came from the Pacific, part came from Mexico, and the combination produced a wind—high, dry, and relatively cold. As the flow passed up and over the mountains, it dropped most of its remaining rain on the western slopes, becoming even drier.

Over the Texas/Oklahoma panhandle the winds collided, and the mountain air, because of its height—18,000 feet this time—overrode the warm air.

The low-level moist air rose, and as it pushed itself upward in huge, expanding bubbly cells, it cooled and dumped its moisture. As the water condensed out, it released latent heat, further increasing the difference in temperature and intensifying the updrafts.

By noon that Thursday, a line of squalls was marching eastward

across Oklahoma. Summer storms—short, not too intense, no problems. But in the radar room, technicians noticed the cells were growing higher, getting more active, thicker. Just before 1 p.m., the National Severe Storms Forecast center in Kansas City, Mo., advised area weather stations that air masses bearing east were unstable, and that isolated thunderstorms could be severe.

Chaff for radar. A few minutes later, Jean Lee, Norman project coordinator, got a call from Joe Golden, an expert in tornado mechanics and leader of the "chase group." "What they try to do," explained Lee, "is get close enough to a tornado to photograph it and to fire chaff into the surrounding area. That gives our radar something sharp to reflect against."

"They're going out in about two hours. Want to go along?"

At 2:15, six of us, along with cameras and rockets and communications equipment crammed into a pea-green Travelall and roared off to find a storm. "We've done this maybe two dozen times now," someone commented, "and haven't yet seen a really intense tornado. Maybe this time we'll be lucky."

"There's a big cloud column building about 35 miles due west," said Dr. Bruce Morgan of the University of Notre Dame from the front seat. He had been talking via mobile phone to technicians back at the lab who were watching developments on radar.

Dr. Gary Achtemeier, an expert in upper air, was driving, whipping along Interstate 40 at 85 mph, weaving in and out of traffic. I was in the rear, being flung side to side. No seat belt. I was unhappy.

At 3:10, we sailed under a huge, ominous black cloud. I braced and looked for a funnel. Four minutes later the sun came out, the blackness was behind us. We kept barreling ahead. "We missed it," I said.

Spotting the "hook." "No. That wasn't anything," said Golden, as we took an exit south. "Just a little shower. But maybe *that* is." He pointed ahead, then took the phone. "Hey, what's happening in the south? I can't see much detail, but a big *cu* (cumulonimbus) is building fast, maybe 4000 feet south-southwest." He listened a moment. "What? Where?" He turned to the driver: "Notch back and south, near Chickasha. Let's go!" We spun off as Golden shouted coordinates of the storm and Morgan located it on a map.

Continued

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Tornado!

[Continued]

On a duplicate map back in the radar room, the men had spotted a "hook," the distinctive radar pattern that shows up only in tornadic storms. In outline, it looks something like Cape Cod.

In the radar room, all lights are out now except those of the instruments. Nine people shuttle about, some with earphones and mikes, occasionally crossing and tangling. Quiet, intense excitement permeates—reminds you of the control room of a space shot (except, oddly, for the incongruous Muzak from the next-door office). Voices overlap on radio speakers. Golden's is one. The others are from the two observation aircraft high above: an Air Force F-100 and Colorado State University's F-101. They measure winds in a tornado's parent thunderhead.

Most eyes in the room are concentrating on the two radar sets, one conventional, the other a new Doppler radar. The conventional radar has picked up the hook; the Doppler has caught sight of a counterclockwise circulation, a whirling motion that often means tornado.

Bulging cloud. Meanwhile, we in the truck had switched to backwoods roads now, so we had slowed to 80. At 4:18, billowing clouds rise before us. We slizzel down a clay road toward them, go over a little bridge and whap! my head hits the roof.

At 4:31, Oklahoma City's KWTB interrupts its programming to announce a likely tornado in the vicinity of Tuttle, 10 miles from Union City. That's right where we are heading.

Twenty-four minutes later the bottom of the cloud we're watching bulges, drops lower and assumes the famous *mammato* shape. It writhes and churns. We're on U.S. 81 now, heading north, 2.2 miles from Union City.

We slam to a stop, and in total, frantic confusion everyone tries to find his equipment: Golden yells for his camera; someone else tries to find electric leads for the chaff rockets; another is hollering descriptions into the phone (being recorded back at headquarters). Photographer Chuck Vlcek, using a borrowed, \$30,000 NASA movie camera, has misplaced the tripod, and settles for the swung-open truck door—but people keep climbing in and out.

"It's down!" The funnel protrudes downward, elongates, looks like a tube—twirling? Or am I imagining it? Then suddenly underneath it a dust devil of dirt whips

up. I'm surprised to see there's open space between the column and ground. Then at 4:43, "It's down!" someone yells, and the column, first steamy white, then darker, stretches to form a solid rigid-looking tube.

I can't get my perspective. We're facing north and the funnel is off to our left. But how far? The tube seems to be a hundred feet in diameter, and that would make it just a few blocks away. Later I found the distance was about 2.5 miles, and the funnel tip averaged one-half mile across.

It begins to move now, to weave like a snake, like a vacuum-cleaner hose, like an upside-down smoke plume, slow-motioning off across the hills. Suddenly it goes black, and I figure it's in a farmer's newly plowed field. I can see tiny bits of material spewing from it. It *looks* like bits, but later I learned the dark puff was the first farmhouse it struck and pulverized, and the bits were whole roof sections and walls.

How does it do that, suck up a house? Dr. Kessler had explained earlier that the intense spin and resulting centrifugal force causes a partial vacuum in the vortex. When the funnel passes over a house, the walls explode outward, and the pieces are carried up, then flung out to the side or smashed back into whatever is left standing.

Tube of heat. The big question is, why the intense motion? Probably it's only a matter of high-velocity winds in a violent thunderstorm meeting and swirling, like the eddies formed when a wave passes a wharf. But some meteorologists believe that lightning is the crucial factor.

A moderate bolt of lightning, calculates Dr. Bernard Vonnegut of New York State University, produces enough energy to heat a tube of air 30 feet across and 10,000 feet high. The air in such a chimney rushes upward into the thunderhead as other air streams in from the side, and the various sheer currents coming from outside impart a terrible whirling low-pressure zone on the inside.

The rotating, sucking winds may range from 75 to 250 mph—but nobody's sure right now. The winds haven't been measured. (Most accurate estimates come from movies in which pieces of debris can be seen twirling.) If it picks up people, goes one rule of thumb, it's blowing maybe 125 mph. If it picks up automobiles, about 200. Once a train car, complete with 117 passengers,

Tornado!

[Continued]

was carried 80 feet, then dropped.

Over us now the sky is blue-black and boiling, with a thousand little mammata writhing. Mean, evil. Suddenly the funnel turns white. "A waterspout!" someone yells. "It must have hit the river."

Storm data. Meanwhile, automatic weather stations around the area (but, unfortunately, not in the tornado's path) were measuring winds, pressures, humidity, rain. In Middleberg, 24 miles southeast, Gerry Wardius, head of the stations, would report later that "winds topped 32 mph, 2.75 inches of rain dropped in just over an hour, and from 4:30 onward barometer readings went crazy." Eventually all the various measurements, photos, radar readings, radiosonde reports, and after-the-fact field reports of survey parties will be correlated.

Back at the side of the road, we watch almost hypnotically as the funnel writhes and weaves to the north, then slowly swings south-eastward in a huge arc around us. (Later I would learn that it could just as well have gone right over us.)

It's 5:06 now, and the tube is to the east, having torn through Union City and circled around us. It bobs and weaves, lighter in color now, narrower, more ropelike. Suddenly it shrinks, becomes a string of beads with some missing, forms again, touches the ground, then sucks up into the sky and disappears.

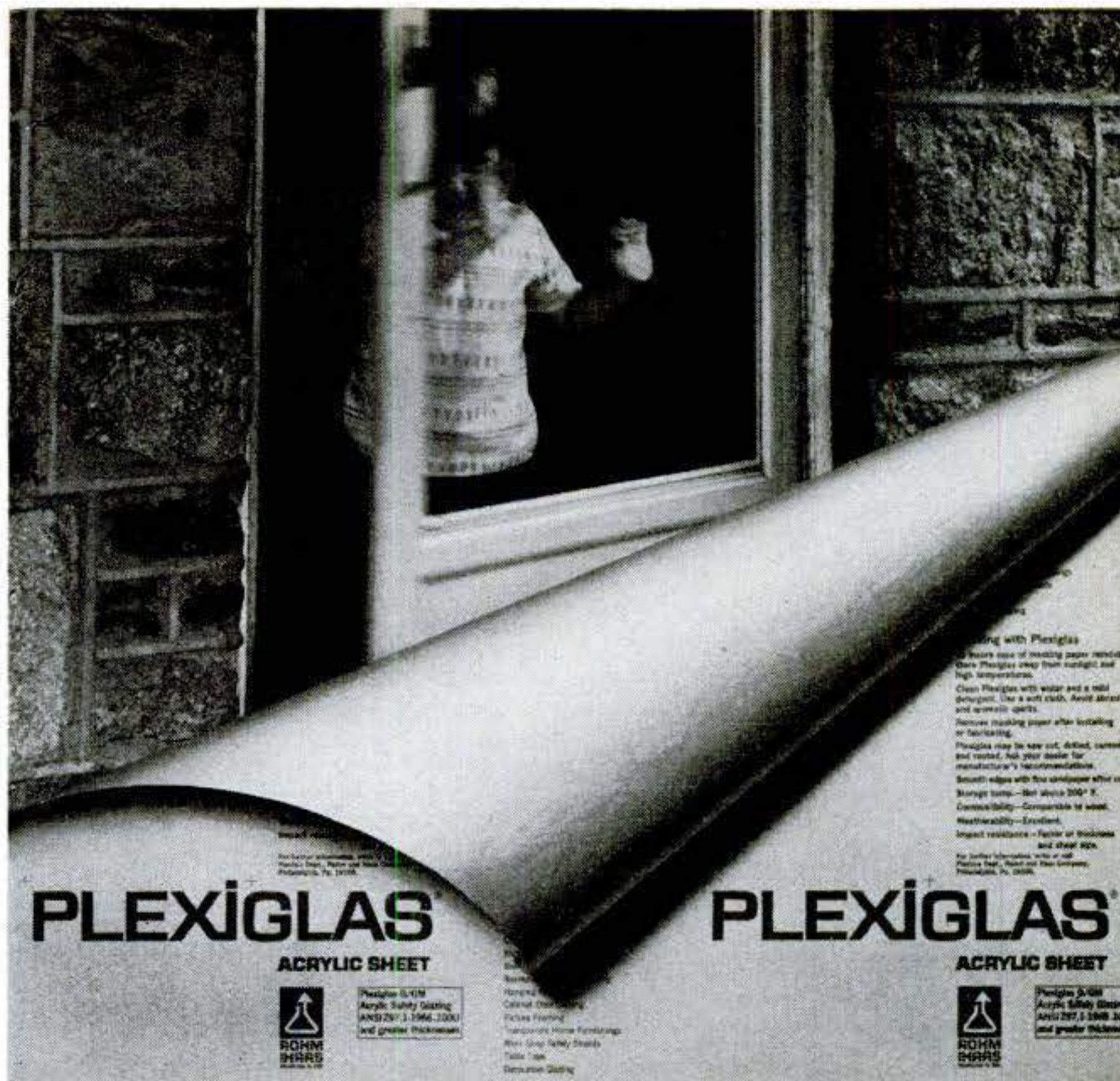
Rain begins—huge drops that immediately soak. And then debris—bits of cloth, shavings of wood, paper pieces—start to flutter down. I reach out and catch a dessert page from a cookbook.

* * *

A short time after arriving in Union City I wrote these impressions in my notebook:

Air smells of plaster dust. Circling meadowlarks wonder where their nests are. Whole town looks like dump, like flood aftermath, like Viet Nam. Leafless tree Christmas-decorated with ripped clothing. Everyone is quiet, hushed. People stand in groups crying or just staring. Cop tells of man plucked from convertible through top, plopped into swamp unhurt. Nail imbedded in tree. Straw too. Woman looks through pile of rubble for "something to wear tomorrow." Yellow blanket in tight roll a thousand yards from nearest house. Dead black angus cow; flies already interested. Woman says she was in her basement storm cellar and suddenly it got light; her house had disappeared.

P 5



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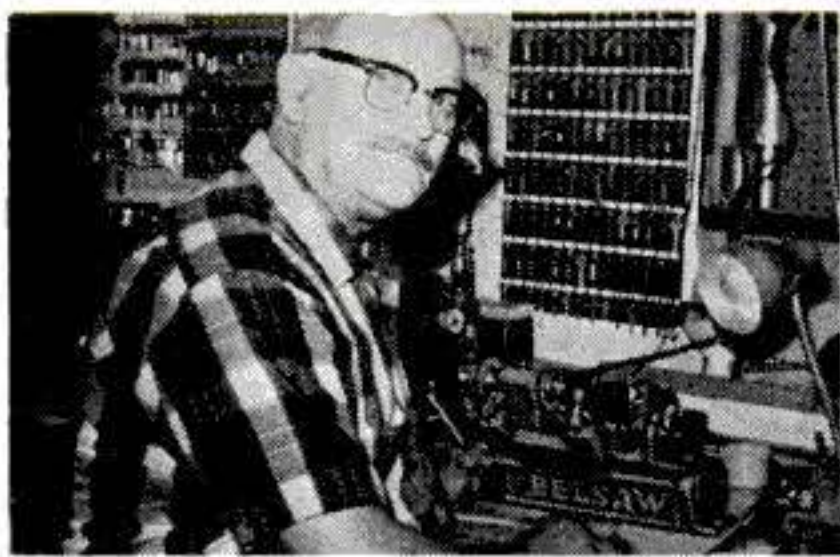
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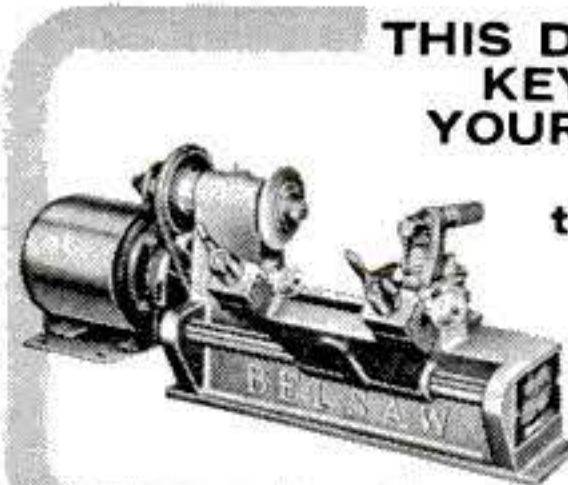
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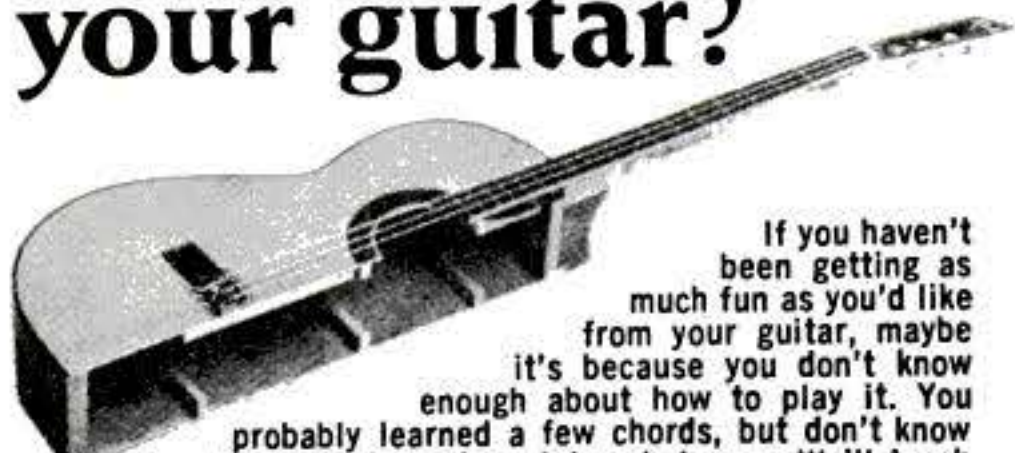
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Protect Your Invention

[Continued from page 36]

gives him two years to experiment, build models, or even try to promote it on a confidential basis before committing himself to the expense of a patent application.

The only thing the Patent Office asks is that the inventor be prepared to show diligence in completing the invention or in filing the patent application. The signed and dated record the inventor should keep while he is developing his invention during this retention period will provide the needed documentation.

How to do it

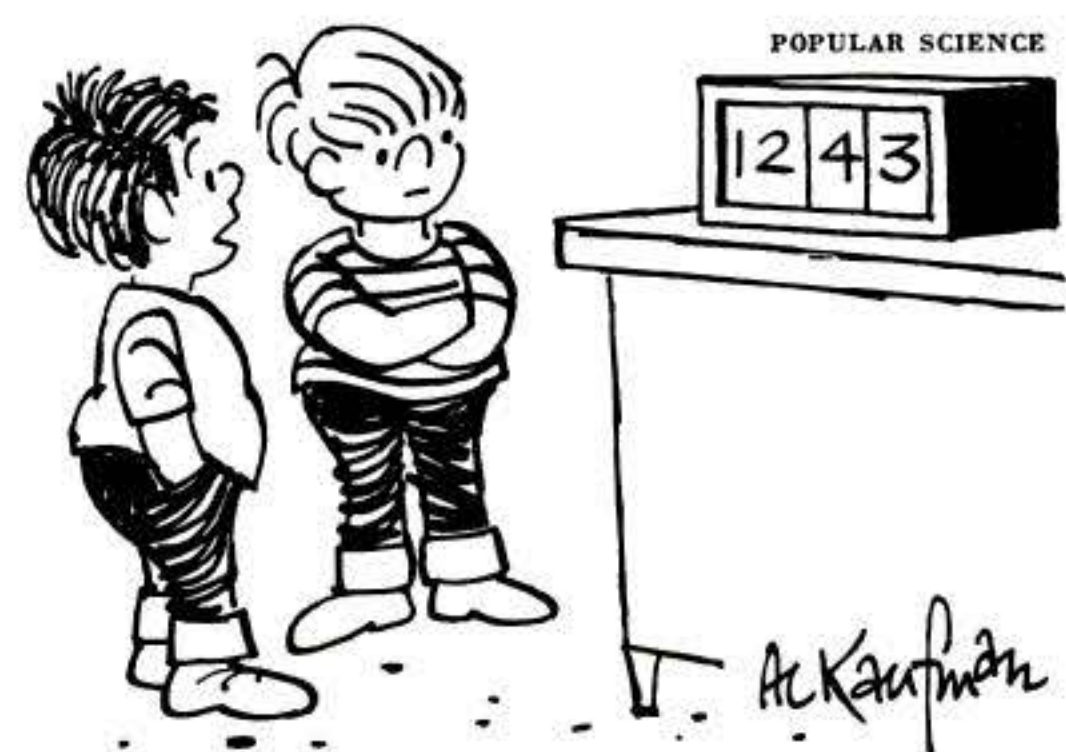
The Patent Office is to be commended for the simplified filing procedures established for this program. These are the rules:

The invention should be illustrated and described as fully as possible on paper not exceeding 8½ by 13 inches (or folded to these dimensions). In addition, a stamped, self-addressed envelope must be enclosed, together with a letter (in duplicate) requesting that the invention be accepted under the program. This material must be accompanied by a check or money order for \$10 payable to "Commissioner of Patents."

Upon receipt, the Patent Office will stamp the papers with an identifying number and date the duplicate letter, which is returned to the inventor. This information and date would then be referred to later, when an application is actually filed.

For a free booklet describing this program in detail, write to Commissioner of Patents, Washington, D.C. 20231 and ask for the brochure "Disclosure Document Program." You can also find a copy at any Department of Commerce field office.

While you're at it, ask for a copy of a booklet called "Patent Office Publications," which lists various booklets and periodicals available to the inventor from the Patent Office, many of which are free.



"Everything's digital read-out these days. I sure miss those little hands and big hands."

TOM McCAHILL SAYS:

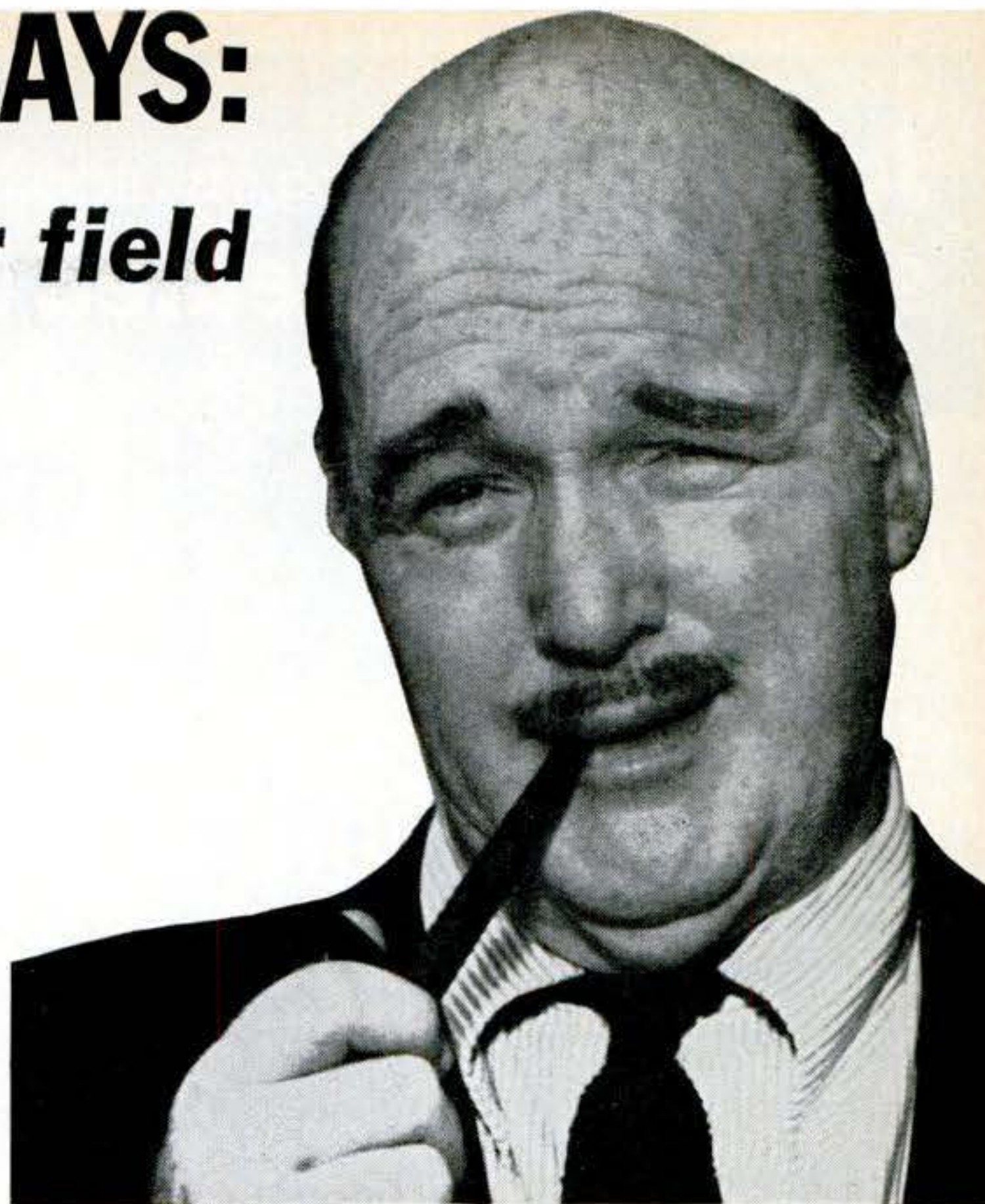
“The appliance repair field is so uncrowded it's almost lonely!”

Someone once said that if you build a better mouse-trap, the world will beat a path to your door. In the home appliance business, a lot of enterprising companies have gotten rich peddling a long list of handy electrical gadgets for the home. The trouble is, the dozen or more appliances in the average American home can go on the fritz, and men with the proper training to do repairs are as scarce as knee-length skirts on teen-agers.

Good Appliance Repairmen are a rare breed these days. Those with a little ambition are booked so solidly you can wait days to get somebody to fix a balky refrigerator or cantankerous toaster. Sometimes, you have to settle for a bum job from a guy who had no business calling himself an Appliance Repairman in the first place.

This brings me to my point. If you want to make money in a field that's begging for trained technicians, there's a fine, low-cost home-study plan available that teaches you how to handle every type of Appliance repair in detail — including refrigeration, air conditioners, and even small gas engines. The course was prepared by the instructors at National Radio Institute. This is the oldest and largest home-study school in the Electronics/Electrical fields with more than fifty years' experience training men like yourself for new careers or spare-time or full-time businesses of their own.

A few years ago, NRI recognized the increasing demand for trained Appliance Repairmen. They set about preparing well-illustrated, easy-to-understand lessons that teach you how to repair home, commercial and farm Appliances. NRI even added a professional Appliance Tester that's included in their low tuition. With the Tester and a few basic tools you probably already have, you're equipped to service most Electrical Appliances. If you aren't making \$5 to \$7 an hour in spare time fixing Ap-



pliances for friends and neighbors within a few months after enrolling, my name isn't McCahill.

The reason I'm no doubting Thomas, is because the staff at NRI is composed of experienced instructors who guide you through the course with more personal attention than you'd get in many classrooms. With the kind of help they give a student and the kind of course they have, you can be the man in demand in this field — even if you've never rewired a plug, or got fed up with school at the 9th grade.

The best advice I can give you is to clip the coupon below and send for the NRI Appliance Training Catalog. It's free, and there's no obligation. NRI doesn't employ salesmen, so nobody will be knocking at your door. All it will cost you is a postage stamp. Take it from Uncle Tom, the Appliance Repair field needs good men. Now.

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Strip Joints

[Continued from page 83]

outdoor benches, tables, and the like.

- Almost always, outdoor furniture of metal. Again, the big-tank system gets into the sharp angles of metal furniture, and it also spares you the tedium of laying remover on all those tiny surfaces.

- In addition, pieces that may be plain ornery. An example is anything that is paint-over-bare-wood. When this is the case, pigments may have penetrated deep into the pores—murder to remove, especially in such absorptive woods as pine. Tanks will probably do a cleaner job.

How to pick a stripper. Despite similarities of materials and methods, there can be a lot of difference in results, one stripper to the next. The reasons: The stripper may or may not be top-notch at his job, and his particular system may not be the best one for your project. For instance, some formulations remove stain as well as finish film. And—some will remove pigmented wiping stain, but won't touch a dye stain.

For these reasons, many experienced users of strip joints recommend that you ask for a test the first time you approach a stripper. Ask him to show you his results on an inconspicuous area of the project. Most of them will gladly do this for you, and although it may not be a perfect gauge of the man and his methods, it gives you an idea.

And, you can learn a lot by looking at finished projects standing around in his shop. Find one similar to yours in style, wood, and old finish. If it came out well, chances are yours will, too.

There's another fairly useful guide: Some strip joints not only strip, but also put on new finishes. Those who do—and particularly those who do finishing themselves rather than farming it out—are likely to do a good job. Their interest is deeper if they think of the complete operation, even if they know that you plan to do the finishing yourself.

What's it cost? Researching this article, I visited eight different strip joints. Their prices were about the same. Typical examples: about \$4 for a chair, \$12 for a bed, \$25 for a desk, \$12 for a panel door, \$2 for a picture frame, \$8 for a shutter, about \$15 for a table.

You can sometimes improve on the prices a little by doing part of the job yourself—such as removing the drawer pulls from a chest. But, considering time and materials, prices are reasonable. And—you can generally count on a better job than you'd do yourself.

P 3

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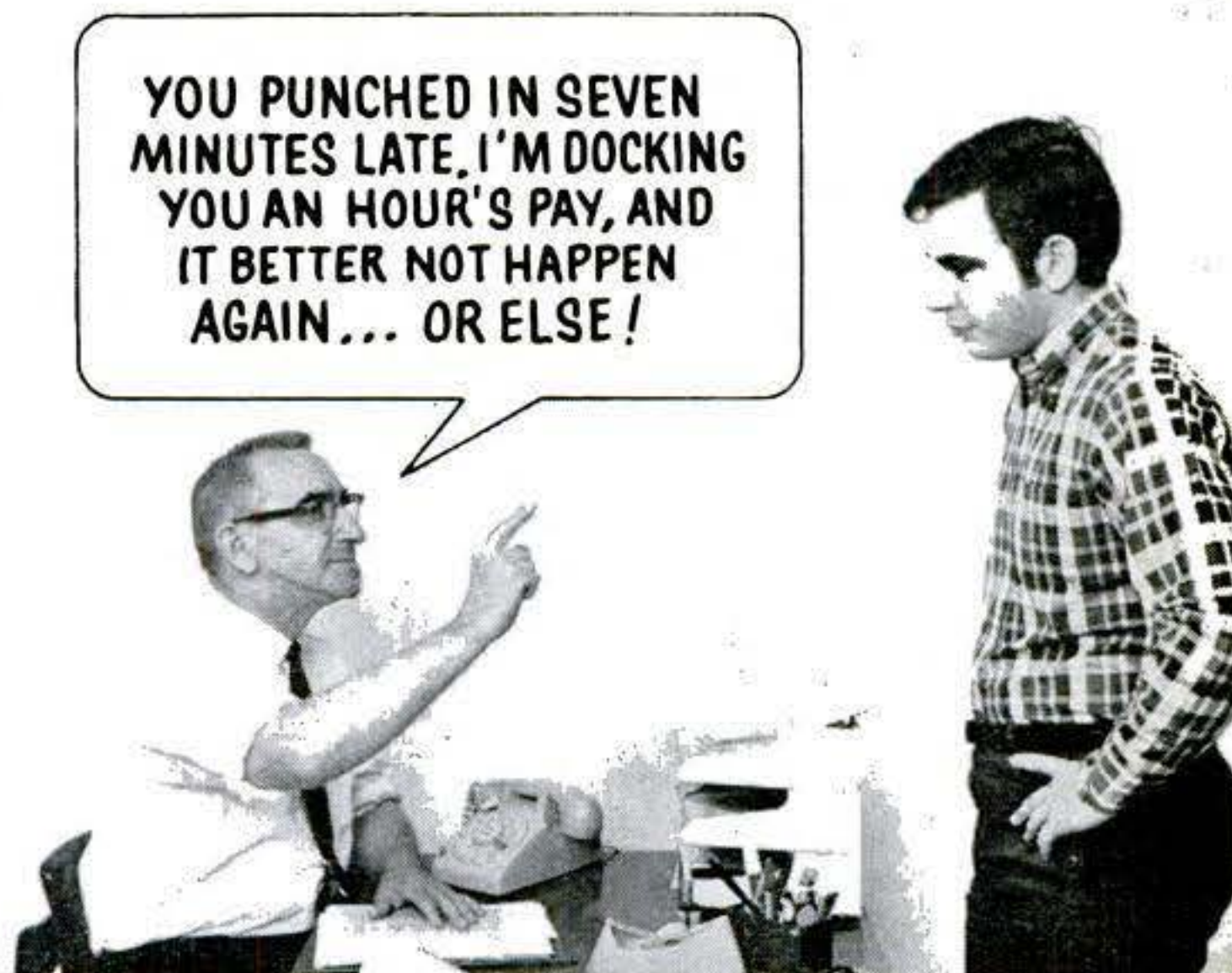
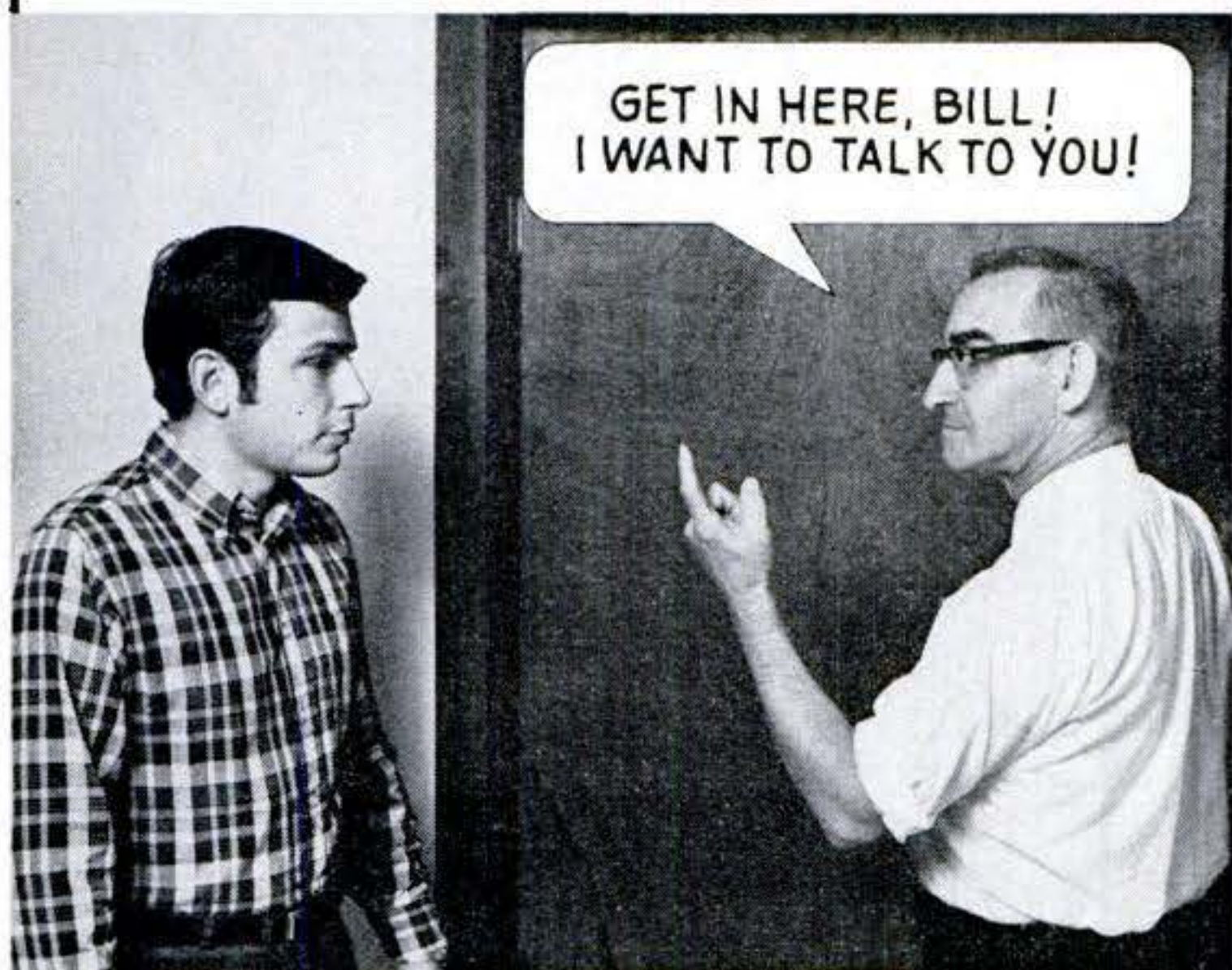
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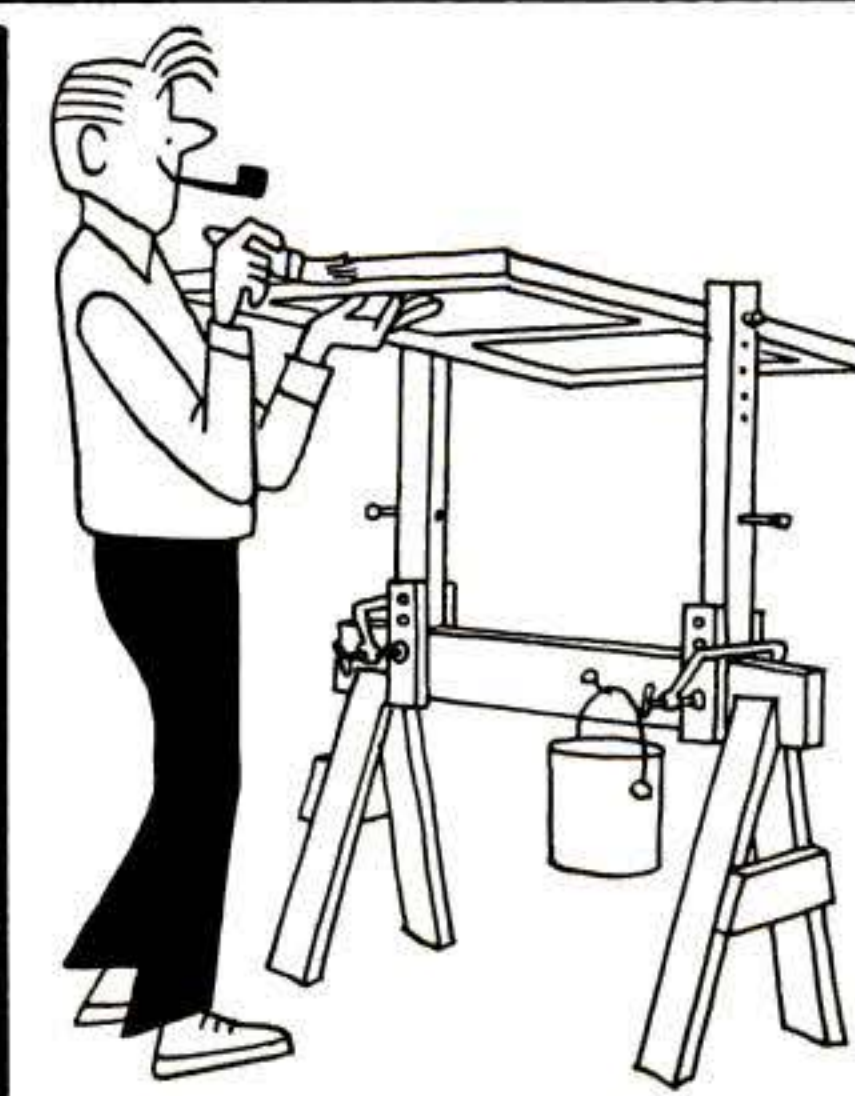
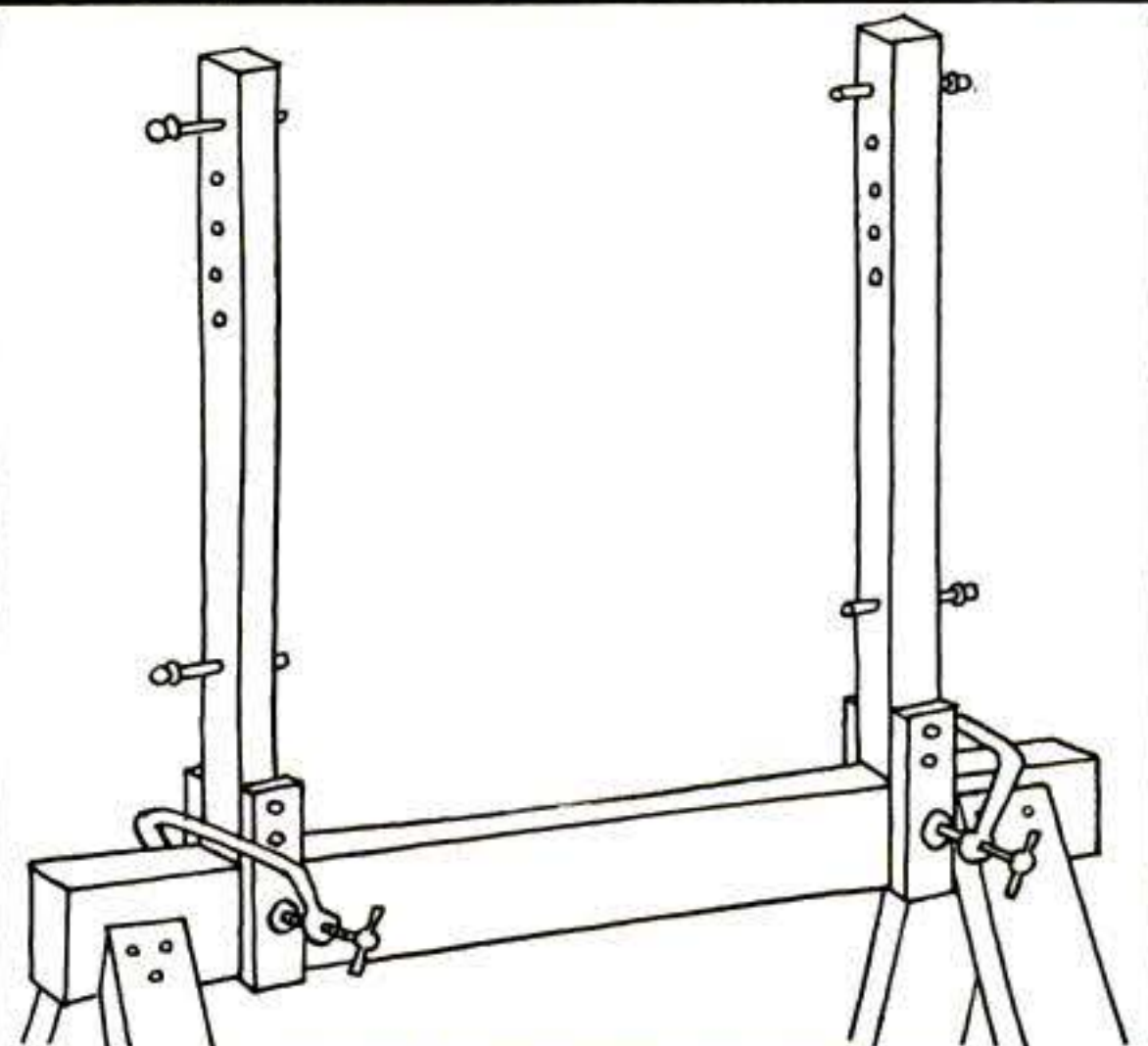
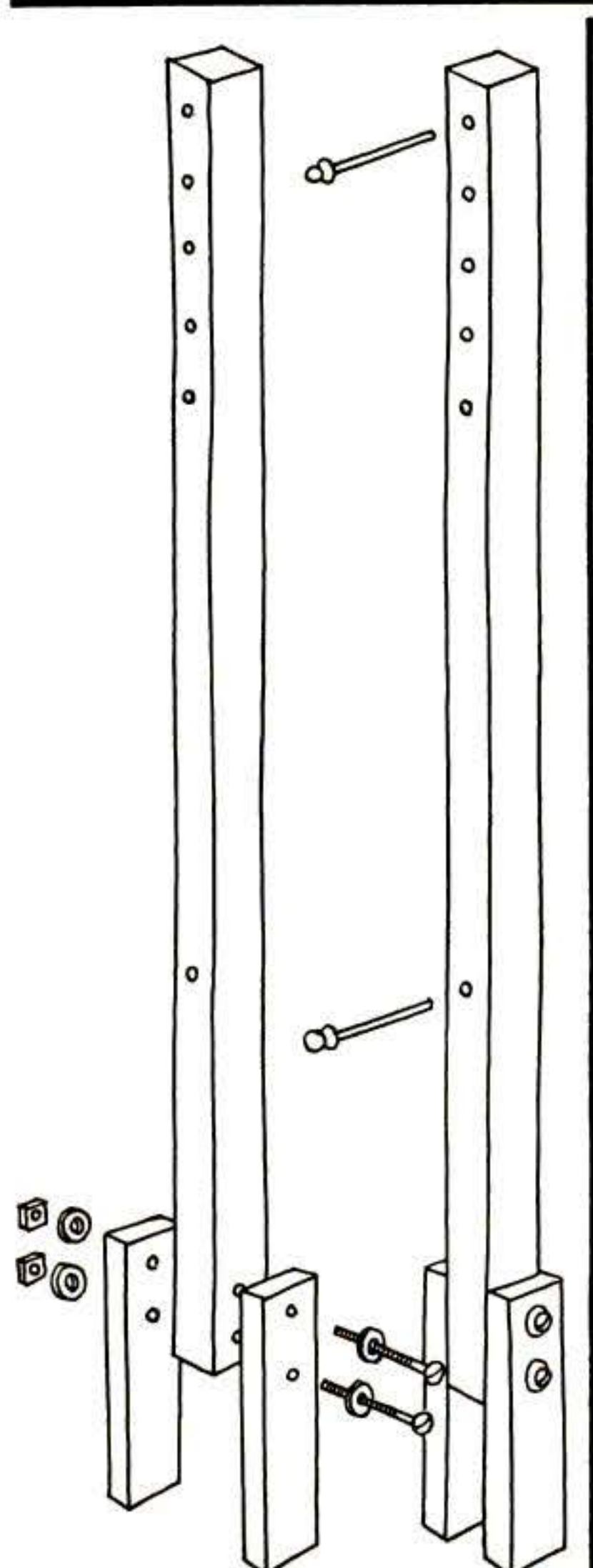


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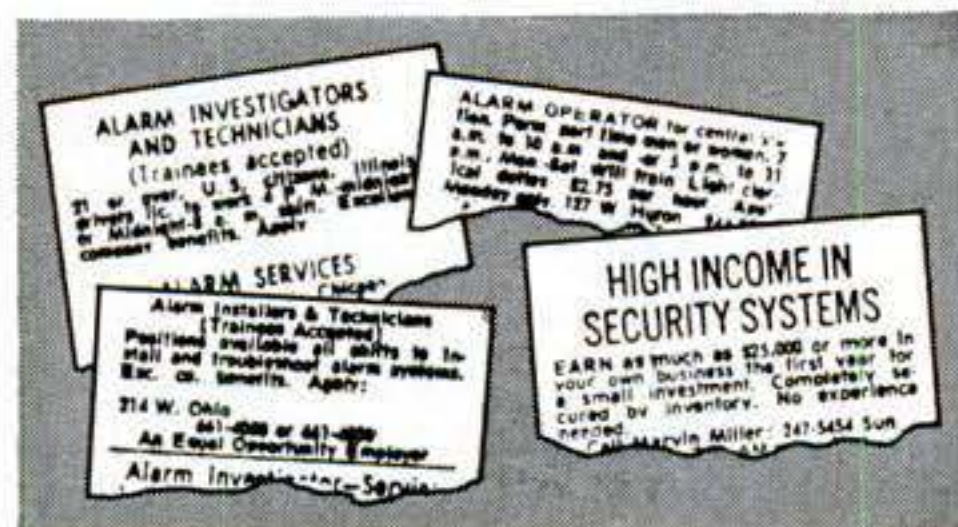
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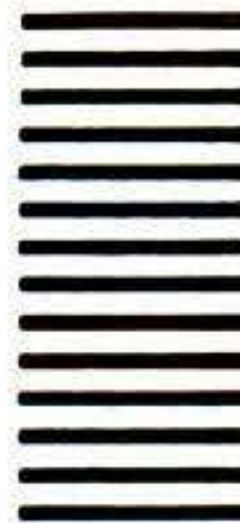
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Two Rooms from One

[Continued from page 97]

tional books, while the upper and lower shelves offer heights of 12¼" and 13½" for taller volumes.

That brick-faced door on the compartment below pivots on "open-end" hinges I adapted from ordinary hangers for window screens. They make the door fully detachable, for access to large "dead-storage" items. Just bend the female portions to a steeper angle, as shown in Detail "A", and mount them in a rabbet cut along the bottom rail of the frame. Though the rest of the frame is of 1-by-2s, I used a 1-by-3 here.

Wardrobe framing. On the opposite side of the bookcase, I stole enough bedroom floorspace to build the wardrobe-linen closet floor to ceiling and wall to wall, broken only by the 2'-wide door opening. The 2-by-2 framing is simple. First, lay out the floor section (or sections, in my case). Then add the uprights and the rails. A wardrobe height of 76" (from room floor to top shelf) gives adequate space for hanging clothes plus 12" of shelf height directly above the clothes pole for hats, boxes, and small luggage. For an unsupported pole of this length, I recommend galvanized water pipe.

The doors are made by cementing prefinished paneling to 1-by-2 frames. The number and size of them depends, of course, on the dimensions of your wardrobe. Four 16-inchers, hinged in pairs from the inside, did my job.

Since the doors fold against one another when opened, the backs are never exposed; there's no need to recess the hinges or panel the rear of the frames. The hardware I used (Acme Fold-Aside) is typical; it has a track at both top and bottom, so both top and bottom edges of each door panel must be drilled to take a pivot pin or roller guide.

Upper doors. Although I could have managed with less hardware for the short upper doors, I installed the same system. A 2-by-2 on the ceiling provides a means for mounting the top track. One extra pair of short doors (not shown in sketches) takes care of the overhead section above the doorway and linen closet.

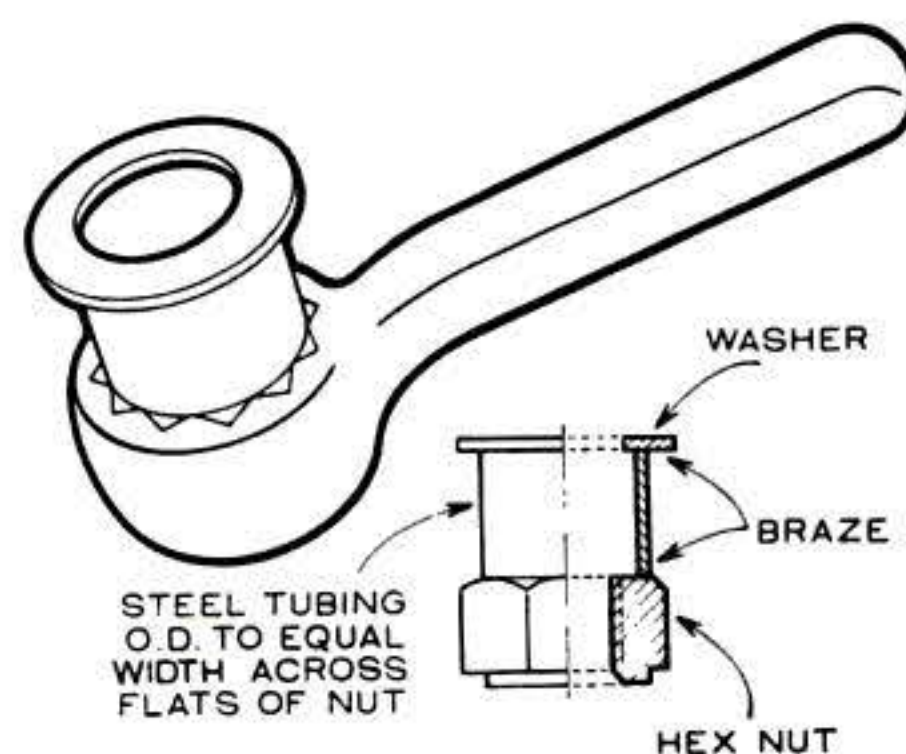
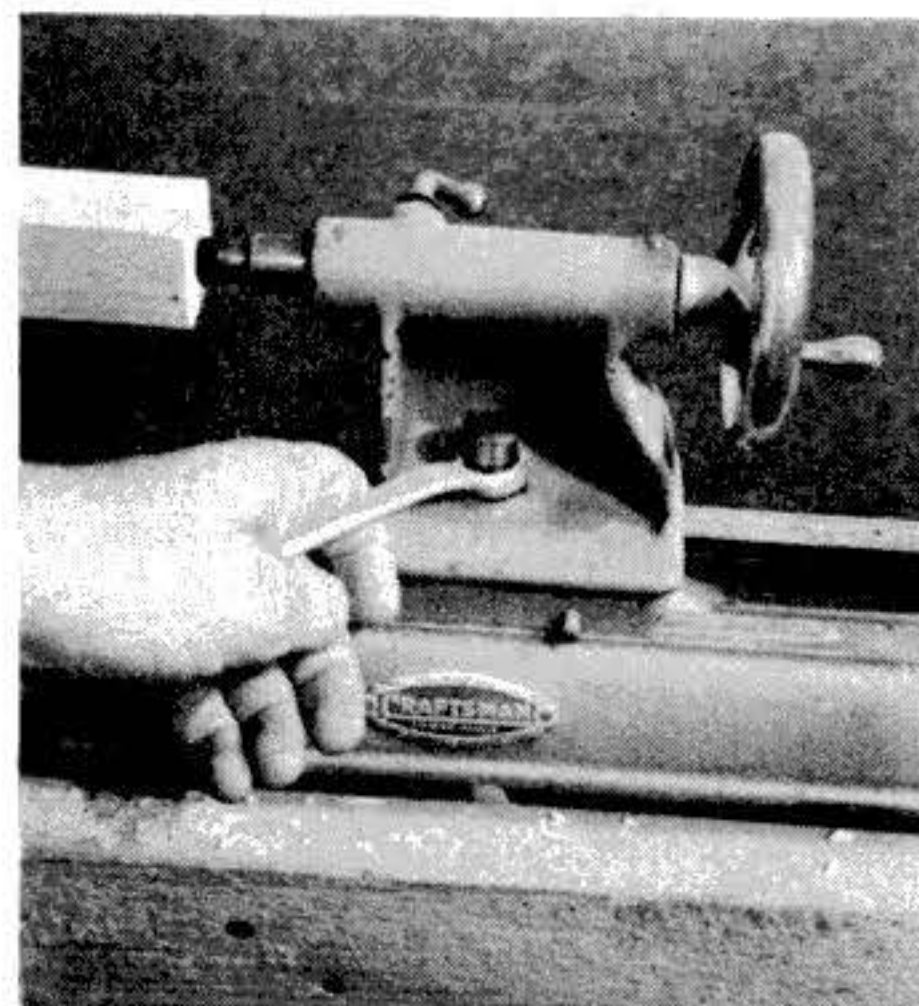
As seen in a photo, it's much easier to build shelves into the linen-closet frame *before* paneling the side.

To complete the project, I ripped leftover paneling into strips and contact-cemented these to all exposed framing—taking care to match the grain and groove patterns.

Now I'm making my family nervous by looking around for other rooms to divide and conquer. **[P5]**

SHORT CUTS AND TIPS

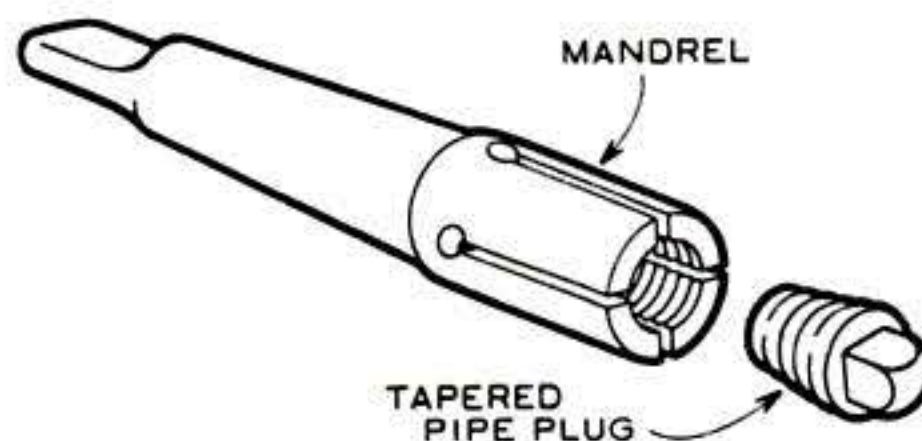
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Wrench guide

These special nuts made for adjustment bolts on tailstock, toolrest, etc. can speed your work. They put an end to misplaced wrenches, and make adjustments easier by guiding the wrench. Cut the tubing just long enough to let you lift the wrench off its nut. To use, just lift wrench for a new bite, drop it down to grip, and turn. The washer keeps wrench from sliding off, aligns wrench (cut-off open-end type) with nut.

ROBERT FINCH, Thousand Oaks, Calif.



Expanding mandrel

A Morse taper blank center and a 1/8-inch-pipe plug make a simple expanding mandrel. Turn the blank center to a light push fit in the work. Using a size R tapping drill (.339), bore the end of the mandrel 1½ inches deep. Tap the hole part way with a 1/8-inch-pipe tap. Slit with a fine hacksaw or slitting saw. With the work in place, a slight turn on plug expands mandrel.

C. W. WOODSON, Herod, Ill.

Want a job doing what comes naturally? Take this test.



A



B



C



D

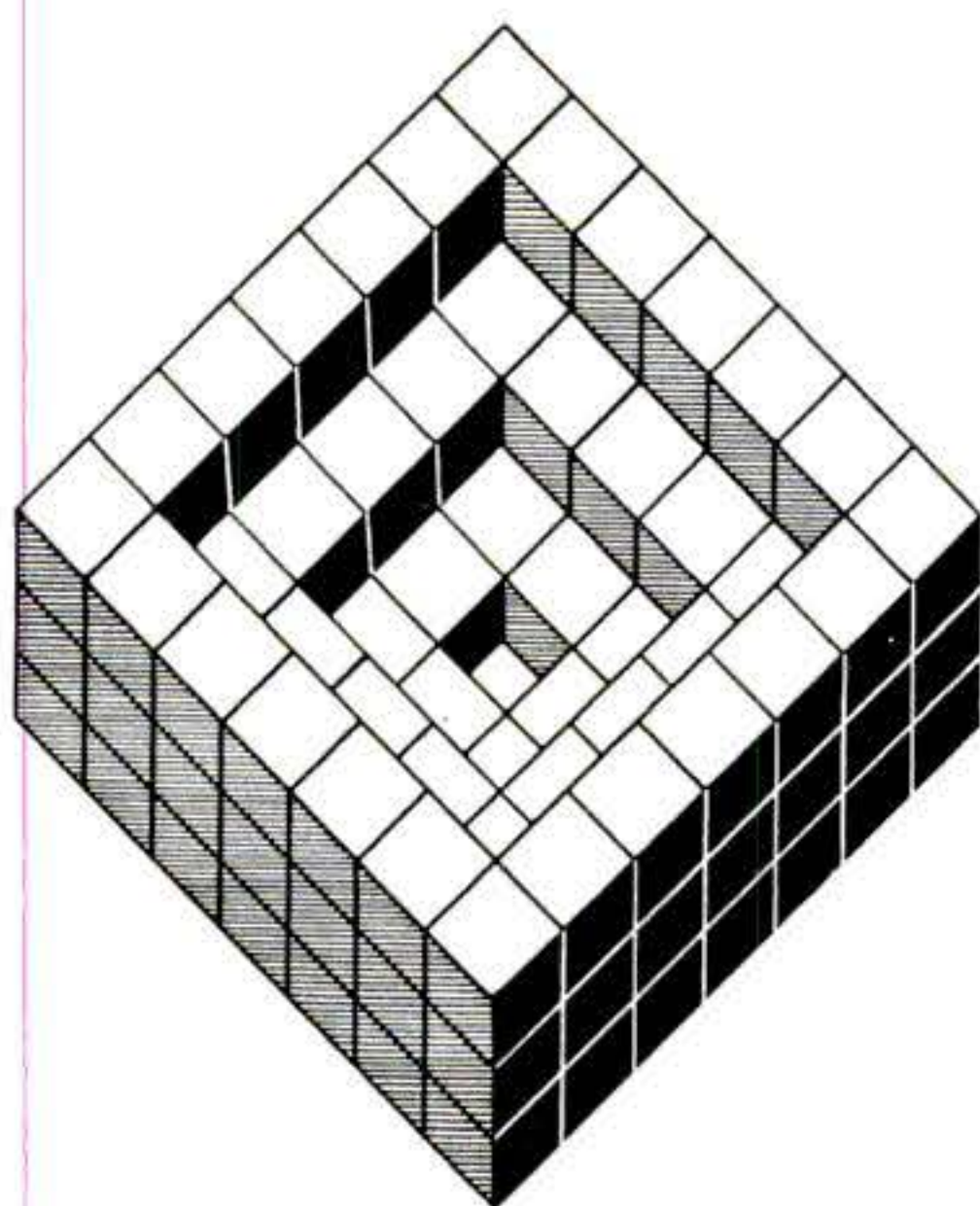


E

Think you're a "natural" technician? Then you should be a lot better than average at spotting the differences be-

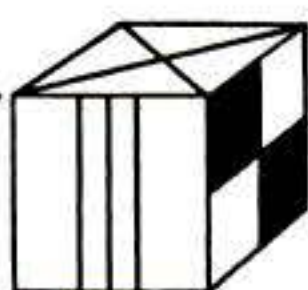
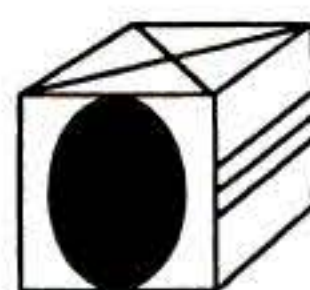
tween similar objects. For example, which part, A, B, C, D, or E has a visible defect?

Answer: D



Here's a tougher one. Give us the right total of cubes in this figure. You'll be proving to yourself you have the kind of clear head and mechanical aptitude that really count for something in the Air Force.

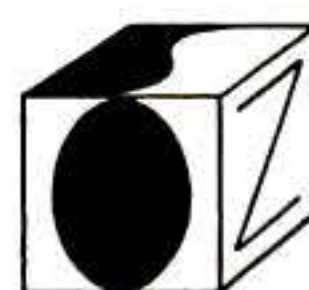
Answer: 112



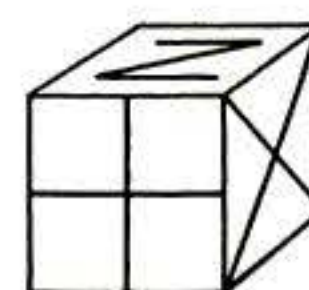
A



B



C



D

Good imagination and deductive powers? They'll help you fly through the Air Force's many types of advanced technical training. Think—which ones

of cubes A, B, C, or D could be the same cube as the one on the left, only turned?

Answer: A, B, C, D

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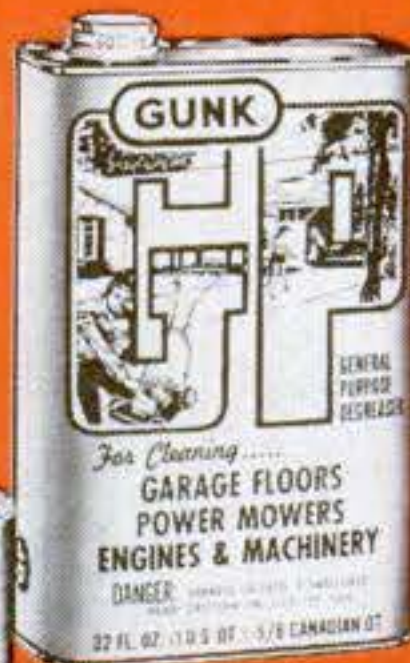
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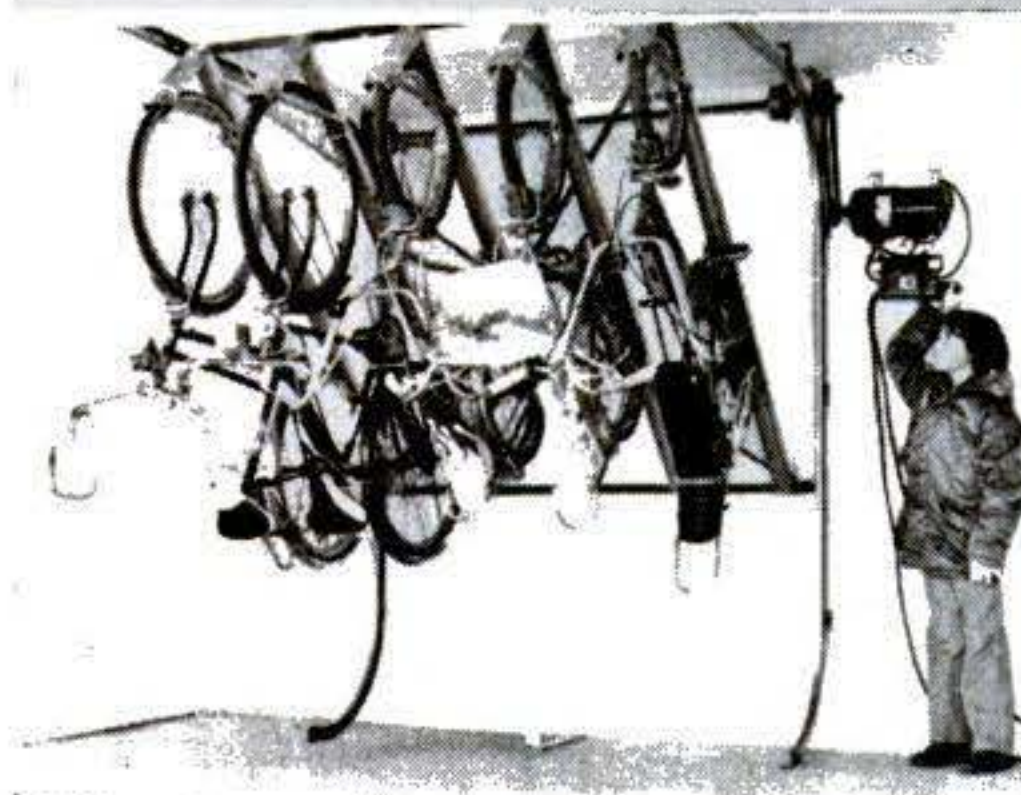
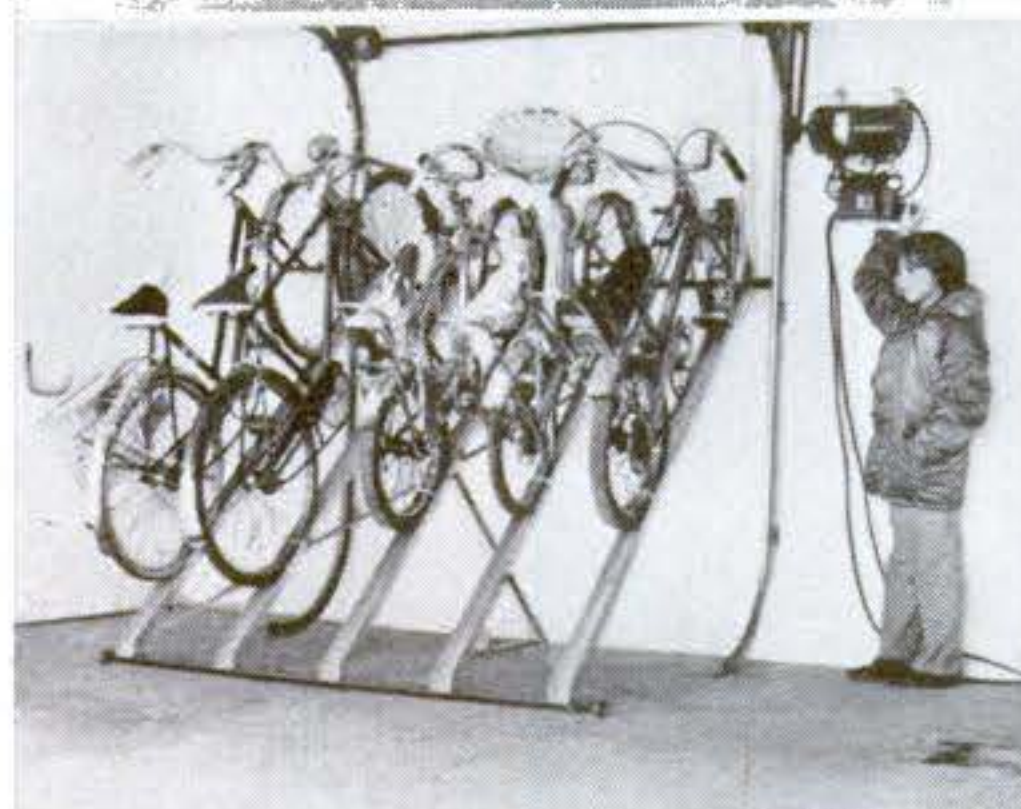


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Inventor's son demonstrates rack: All you do is roll on the bike, clamp down

the wheels (not shown), and press a button. Presto! Motor moves rack to ceiling.

Motorized Rack Stores Bikes on Ceiling

William Kolker got tired of coming home every night to a bike-cluttered garage. Solution? Build a motorized rack that clears off the floor by storing the bicycles on the ceiling. When the family's five bikes are stored safely "upstairs," he has plenty of room for the car.

The bike holders are made of extruded aluminum channel and the wall frame and roller bearings are

the same as those used in conventional garage doors. The 1760-rpm electric motor is geared down to 30 rpm with automatic stop in either direction.

There's an added safety factor: The kids can't get their bikes out until the car is out. Kolker (3766 Downers Dr., Downers Grove, Ill. 60515) hopes to sell his patent-pending invention to a bike maker. **PS**



Underside of 4WD van has front-wheel-drive unit in a neat and smooth-working package. The suspension has been beefed up also, so you can take the rig off-road with confidence.

Cruisair sits higher than standard vans to accommodate the extra drive unit and the large tires needed to negotiate the rugged, off-road terrain it's designed to cross.

4WD VAN: Tough off the Road ...Smooth on the Highway

Traveling off the road is lots of fun, but when you're really out in the boondocks there's little in the way of creature comforts.

I just tried out a four-wheel-drive van camper that takes you off the road for extended trips, and contains most of the comforts of home, too. It's the 4WD Cruisair, built on a Chevrolet chassis, with a three-speed automatic transmission.

At first I hesitated to take the Cruisair into the outback. But after picking my way through some boulders, I found it could be driven off the road with ease. Stream beds were simple to cross, hill climbing stable and sure. And though it's fairly heavy, it didn't bog down in sand or mud.

You select drive mode with a floor-mounted shift lever. It has four posi-

tions: low-four, high-four, neutral, and two-wheel operation. When shifting to off-road ranges, you must lock the front hubs.

Inside, the Cruisair has everything you need for living and meal preparation. Base price for this combination of luxury and ruggedness is about \$9300. It's made by Cruisair Motor Corp., 945 W. 190 St., Gardena, Calif.—*Jim Davis*

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Soil-Cement—It's Dirt Cheap

[Continued from page 95]

bag of portland cement for every 24 square feet of surface area. If the project were a driveway 12' wide, 4'-by-6' grids would work perfectly, arranged crosswise or lengthwise. Each rectangle gets one bag of cement spread out evenly over it.

Caution: Spread only as much cement as you can work at a stretch—as soon as the cement contacts damp earth, it begins setting up; keep going right through to the last step.

When you have an even cement spread, start mixing. If there's much area to do, rent a roto-tiller. Otherwise, mix with whatever hand tool works best: rake, shovel, or hoe.

Don't sweat small rocks; mix them right in. Big rocks interfere with the thorough blending of soil and cement and should be culled out. Mix to chosen depth as closely as you can. Too deep gives a thicker pavement but a weaker mix. Too shallow gives a stronger mix but a thinner section. Check with our shovel test.

Adding water. At this point your soil-cement job will be quite dry and dusty. Although most soils contain plenty of moisture, the addition of cement and the blending operation dry things up. To provide enough water for cement hydration—the hardening process—and good compaction later, spray with a garden hose as evenly as you can. Then mix again to full depth. When our hand-squeeze test shows that your S/C has the right amount of water, rake out the surface smoothly.

Now you're ready to compact. Do it with a hand-tamper, at first. I like a 6'-long 4-by-4 with a piece of plywood nailed to the business end. Doc Vaughan says he prefers using a 2-by-10 flat with two handles nailed to the sides.

You can rent a power tamper for not too much. Or, after a once-over by hand, bring your car's weight to bear. Drive to and fro wherever there's room to maneuver. At any rate, this initial compaction should leave the soil-cement firm and dense.

Scratch the uneven surface all over with a garden rake. Grade it out evenly with a board, then hand-tamp it again. During this final compaction, moisten the surface *slightly* with a fine spray from a hose. A smooth lawn roller can be run back and forth over the slab for an improved surface. But don't expect a perfectly flat pool-table finish. You're working with 90-percent dirt. Foot and tamp-marks can be removed with a fine spray.

Like concrete, soil-cement pavement should be covered or kept damp

by sprinkling for several days or more. Cover with newspapers, canvas, polyethylene sheeting, whatever is handy. If you sprinkle-cure, do it lightly the first day. After that you can spray as much as you like without damaging the S/C. You could begin using your slab right away, except for foot and tire marks. If they won't detract from the appearance, go right ahead.

Rain—except for the worst gully-washer coming right after final compaction—shouldn't hurt soil-cement, unless by undermining the slab in a washout. The dirt-cement itself won't be affected. I have seen sections of soil-cement pavement that were completely tunneled under by flood water, and cars were driving over them. The soil-cement formed a short, effective bridge.

To surface or not. Soil-cement roads and streets get a bituminous surface treatment to keep traffic from abrading them. Whether or not you put such a surfacing on your project depends on your climate as well as your preference.

It does help S/C to withstand severe weathering. If you live in a cold northern state, you may want to top off with an asphalt treatment. On the other hand, the asphalt will hide the natural dirt appearance of soil-cement, so you may prefer to wait and see what a winter's exposure does. Then if there's surface scaling or abrading, you can add the protective topping next spring.

To do it, get a five-gal. can of emulsified asphalt—the kind used for cold-applied roll roofing. For better penetration, thin it with a solvent as directed on the label (1/4 part thinner usually does the job).

Brush this mixture liberally over your cured and cleaned soil-cement. Before it dries, cast a thin layer of sand over the surface using a flat shovel. Asphalt will bind the particles of sand into a thin protective layer adhering to the soil-cement beneath. Until dry, don't walk on it and risk tracking asphalt into your house. When it's completely dry, just sweep off the excess sand.

Doc's tips for you. Use either Type I or Type II portland cement. Avoid cements billed as "plastic cement" or "mortar cement."

If you are in doubt about how much cement to use in your mix, emulate the engineers: Make test samples. Parcel out varying volumes of cement and soil with a kitchen measuring cup. To sample a 10-percent cement content, for instance, add one cup of cement to 10 of dirt.

Soil-Cement—It's Dirt Cheap

[Continued]

Mix as you would out in your yard and compact into a tin can. Keep the samples damp for about a week and then check on their hardness. (Not hard? Too little cement.) Hit each sample with a hammer for the best "ring." Once you know the right amount of cement for your own soil, you can size your cement spreads confidently from the table.

Cool weather is best for making soil-cement, both for comfort and because the mixture stays workable longer. Don't try making it in freezing weather, though.

Big project? If it covers more area than you can handle in a single go, divide it into sections. Finish one before starting the next. Just be sure that when you mix next to a previously made section that your blending is carried about an inch into older soil-cement. This ties the two sections together.

As the added moisture leaves soil-cement, you'll notice tiny shrinkage cracks in your slab. Clay soils shrink more than sandy ones. In any case, the cracks won't hurt, says Vaughan. They're normal.

If black or dark gray dirt is all you have and you'd still like to mix up a little soil-cement, you can. I've done it in setting posts, where I wanted to use the black dirt dug out of the hole. Simply make up an extra-rich S/C mixture with the black dirt. Use, say, 20 percent cement in it. Add water, and backfill with it.

A flagpole I set this way had to be removed a year later. I found the soil-cement surrounding the pole almost as hard as concrete. It had to be broken away with a sledge hammer. At 20 percent cement, my black S/C mix is as rich as concrete, but without the other select materials concrete would have. The cost, naturally, was double what it would have been with a more suitable soil and a reasonably low cement content.

Using dirt-cheap paving, you can lay a huge 20'-by-25' patio for only \$40. Or a 10'-by-30' stabilized driveway-parking area for just \$25. Or you can mix yourself a 2'-by-80' meandering garden walk for about \$10. Who says today's home-improvement costs are out-of-sight! **PS**

How much cement to use

SOIL TYPE	CEMENT (by volume)	ONE BAG WILL COVER:		
		4" deep	5" deep	6" deep
Sandy or gravelly	10%	30 sq. ft.	24 sq. ft.	20 sq. ft.
Heavy with clay	12%*	25.8 sq. ft.	20 sq. ft.	16.7 sq. ft.

*For better frost protection, use 14%.

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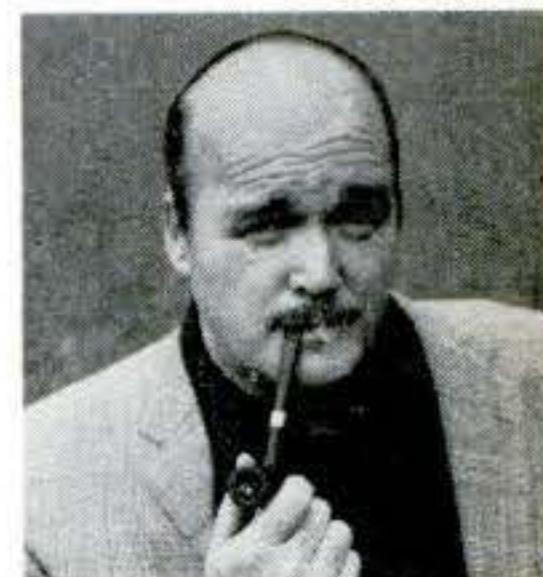
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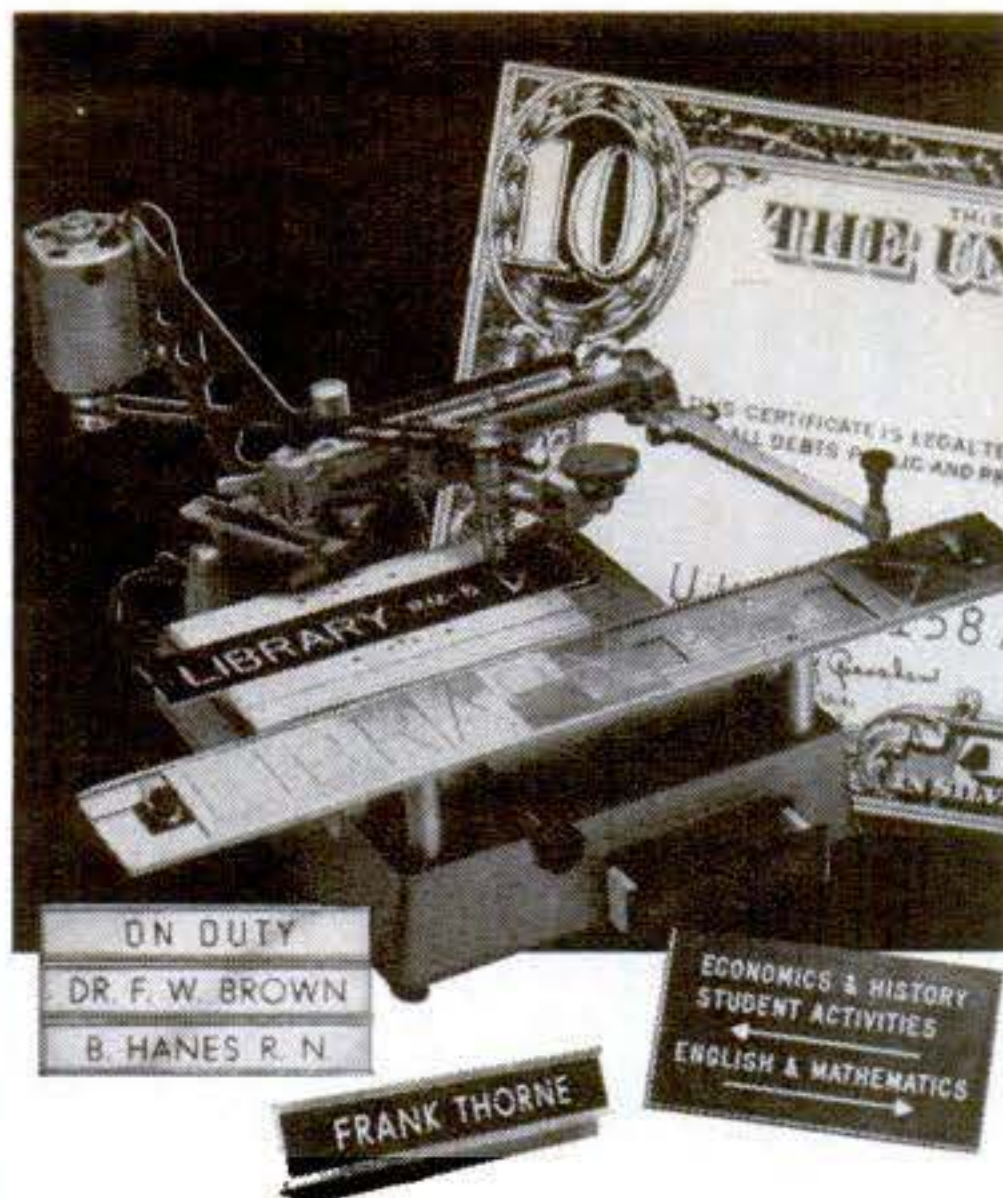
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Only accepted material will be acknowledged; none can be returned unless accompanied by a self-addressed, stamped envelope. In case of similar entries, the one bearing the earliest postmark will qualify. Projects that don't qualify for this competition may be purchased at our regular rates for other use in the magazine.

The winning project for the fourth month will be presented in our January issue. To qualify, entries must be postmarked no later than October 1st. Send yours to: Weekend Project Editor, Popular Science, 355 Lexington Ave., New York, N.Y. 10017.

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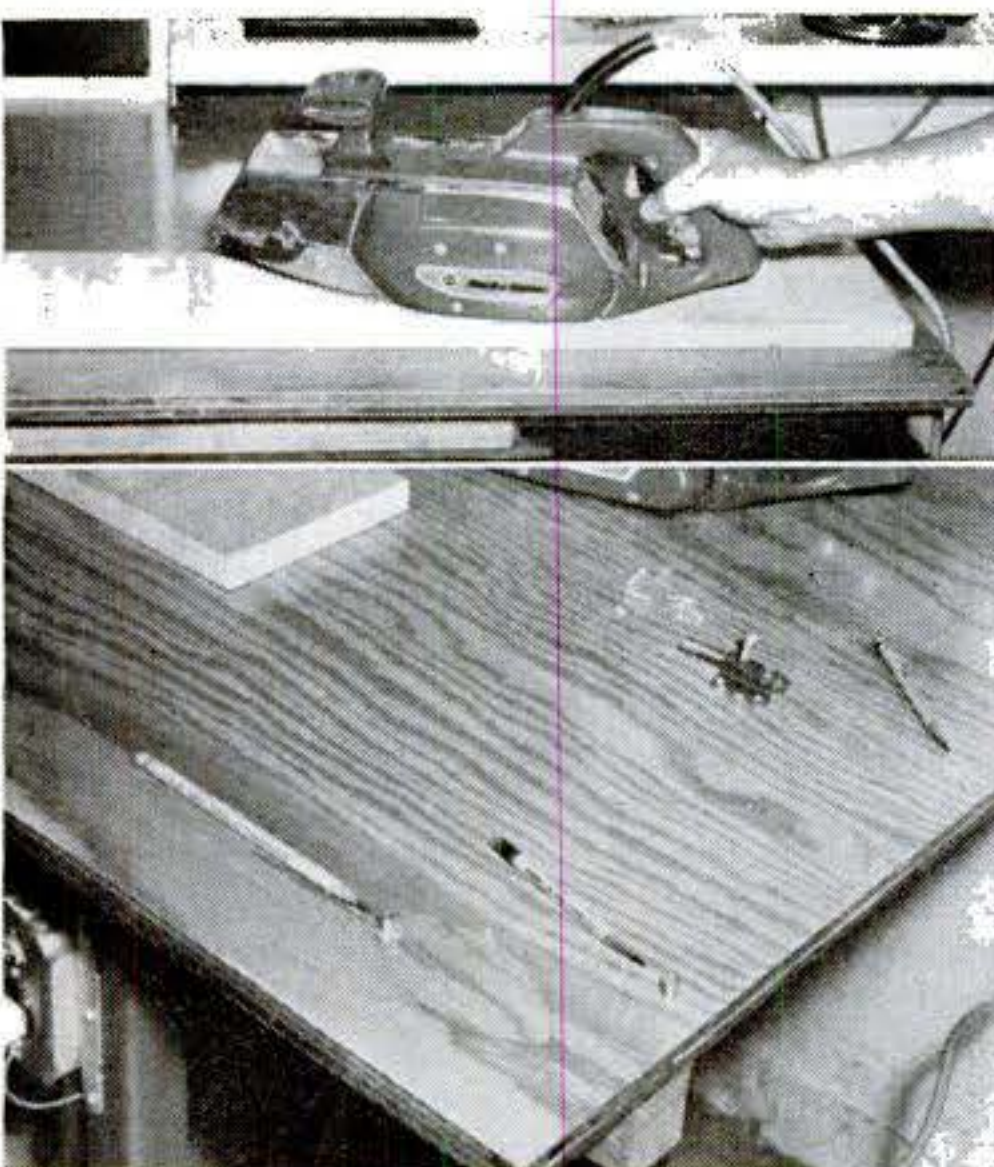
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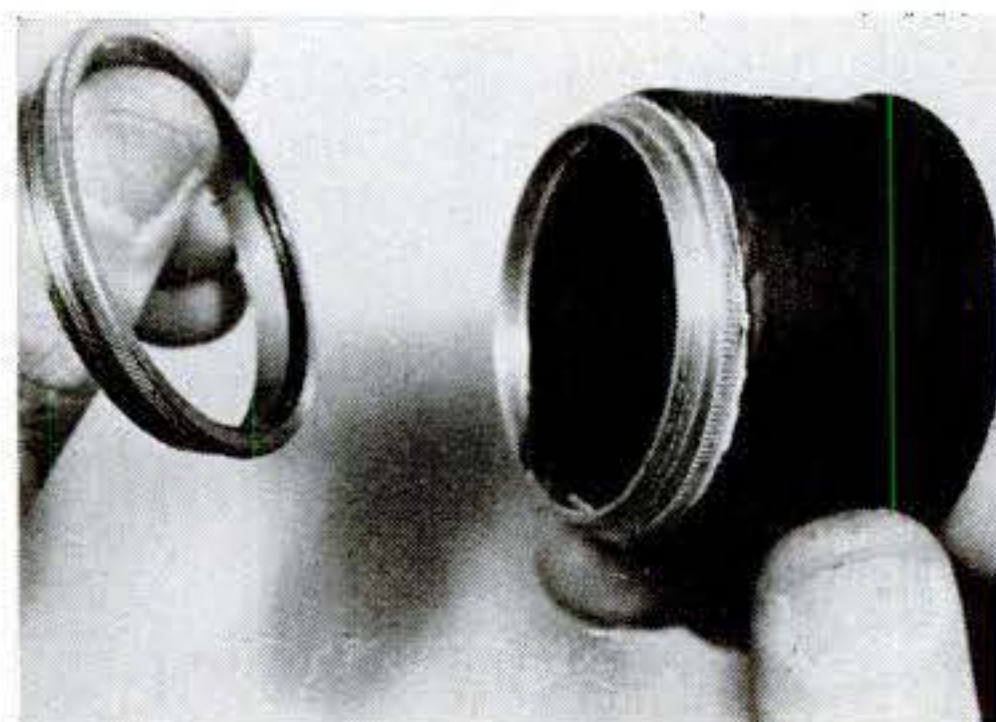
SHARED BY PS READERS



Wire-brush lifesaver

Wire brushes that lose their bristles usually do so because the bristles rust inside their handle sockets. For longer brush life, lay the tool on its back, fill sockets with metal primer. Repeat until sockets are full when dry. The brush will hold up even on wet jobs.

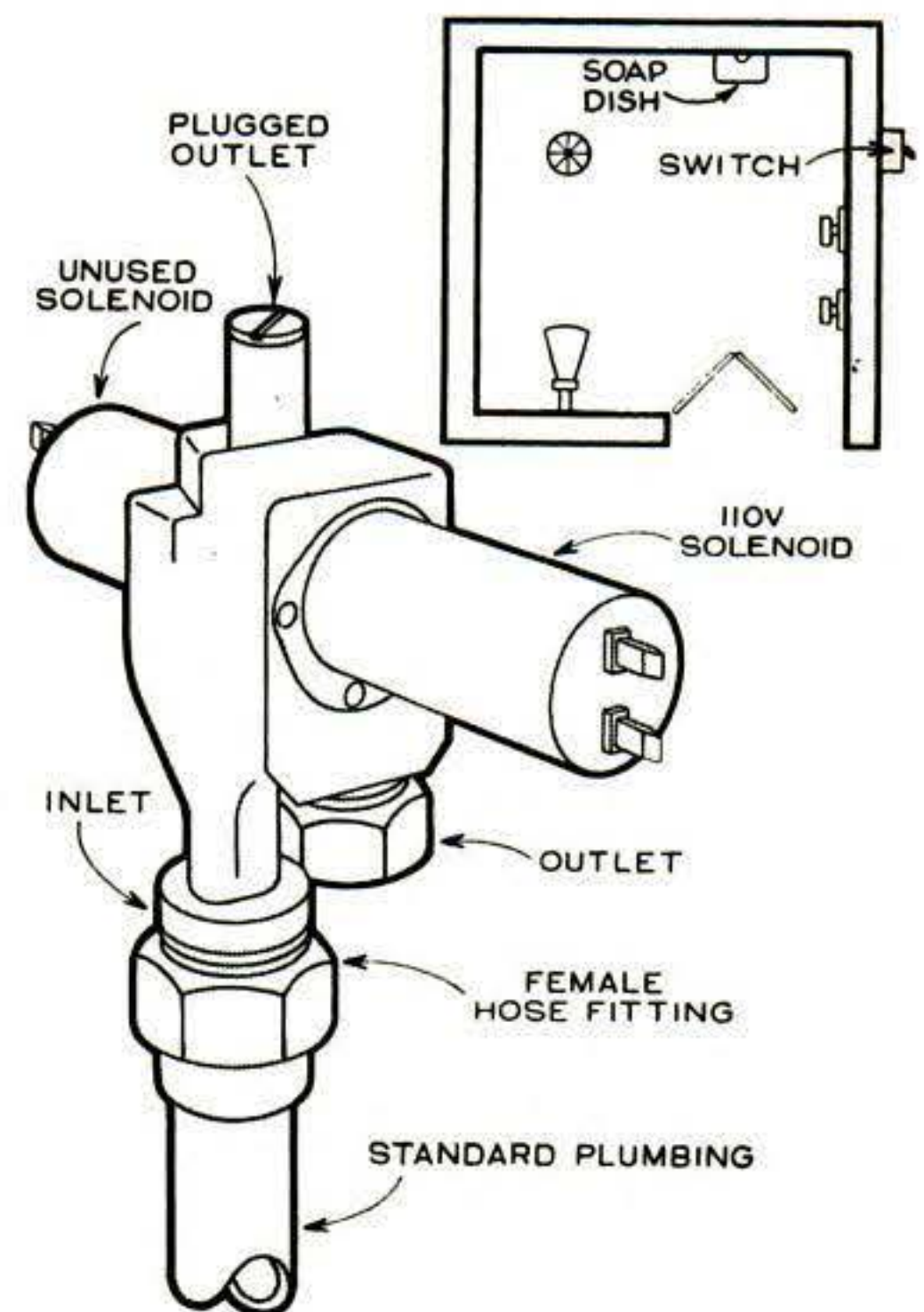
ALBERT HENRY, Front Royal, Va.



Aerosol cap to lens shade

Plastic snap covers found on aerosol cans are ideally suited to making lens shades. They range in size from series V up to VIII. Find the size you need, cut out the top, and glue in a filter-retaining ring. Spray the shade flat black. Be sure to check for vignetting before using on a wideangle lens.

WARREN SHEPARD, Livingston, Mont.



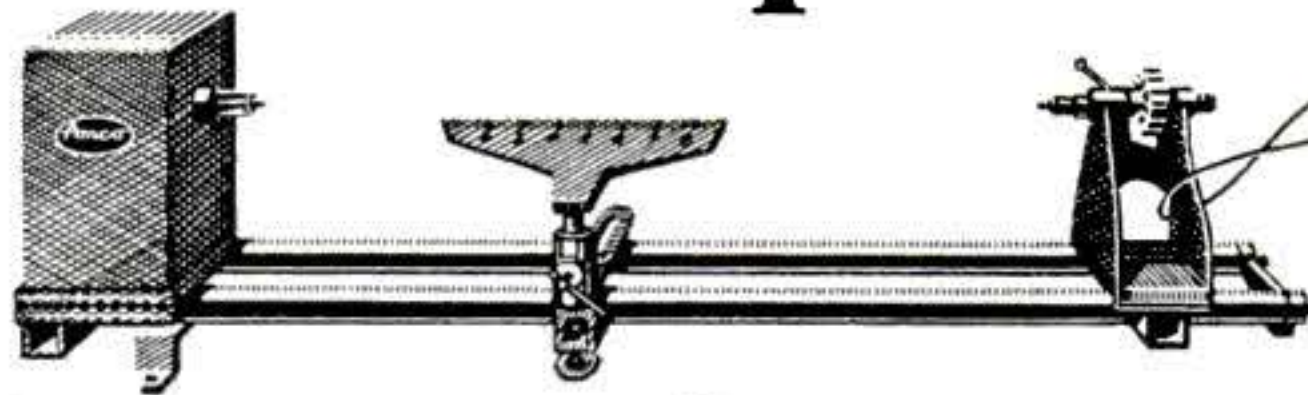
A switch for your shower

A solenoid-operated valve from an old washing machine lets me control my shower by a switch—independent of the mixing valves. I flip the switch 10 seconds before I'm ready and have the same temperature flowing as when I last stepped out. Washer valves vary. Sketch shows how I modified mine.

CURTIS KINDREN, Dove Valley Way, Ga.

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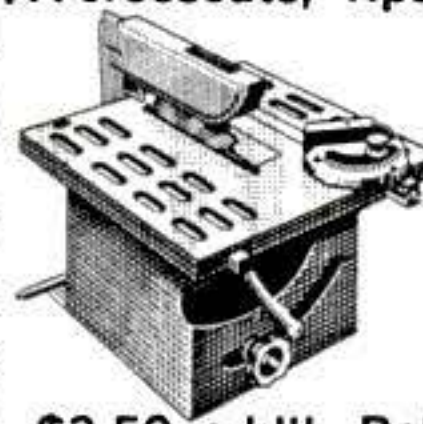
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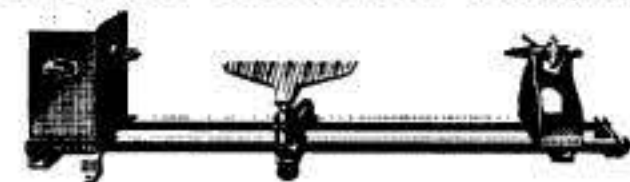
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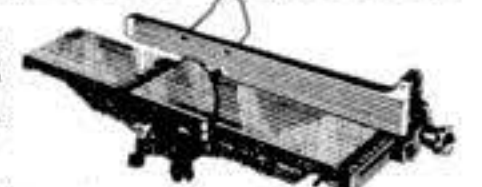
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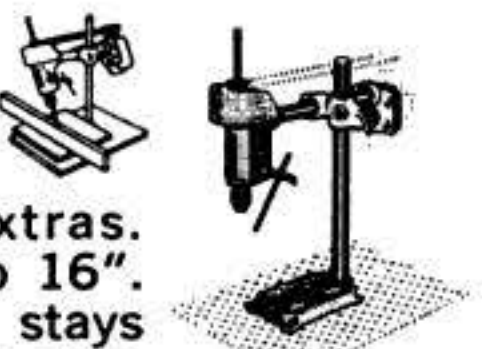
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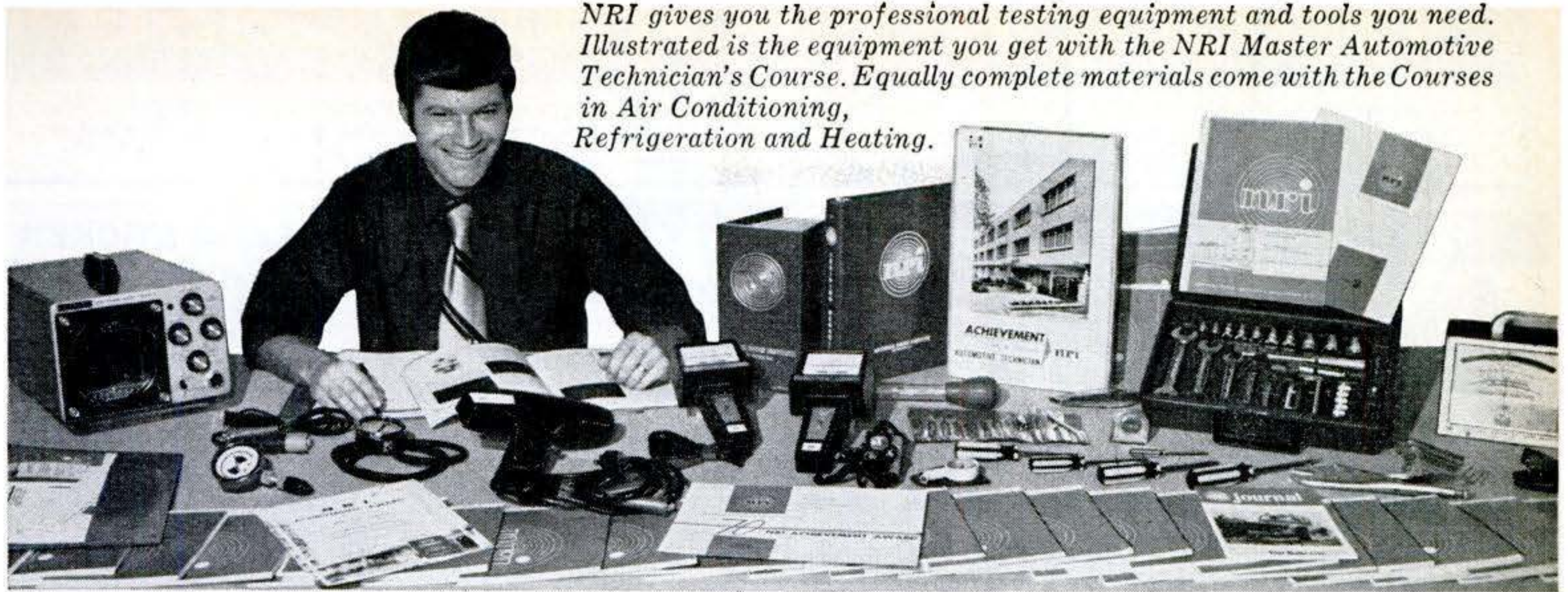


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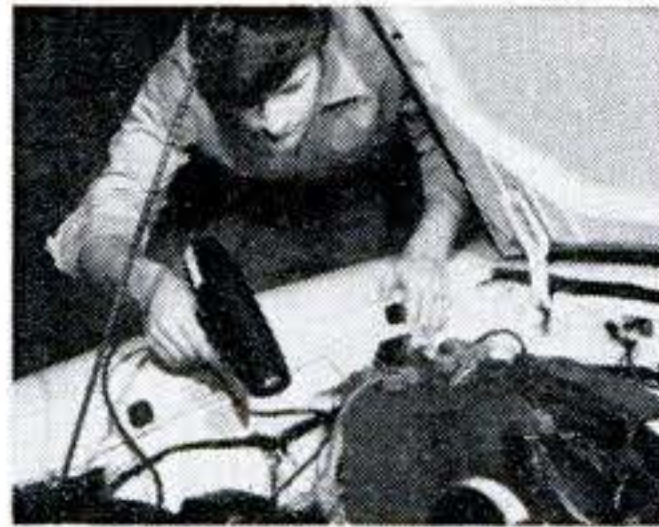
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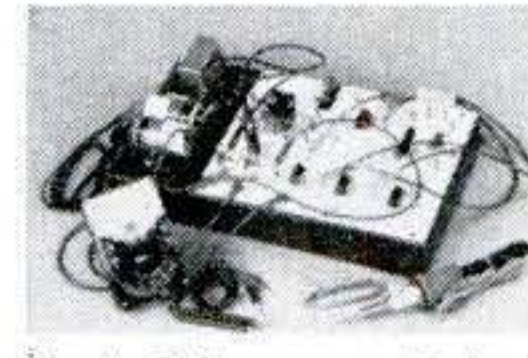
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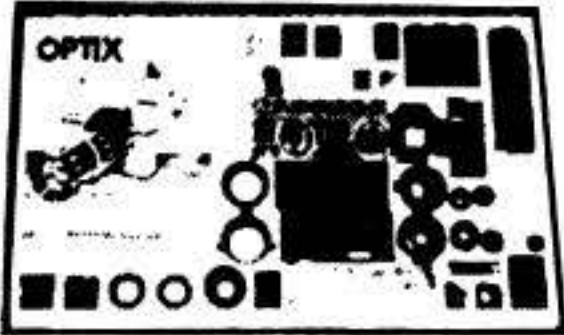
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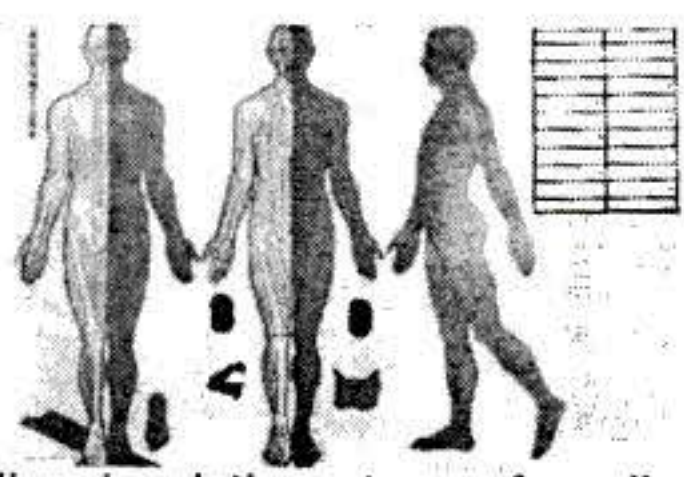


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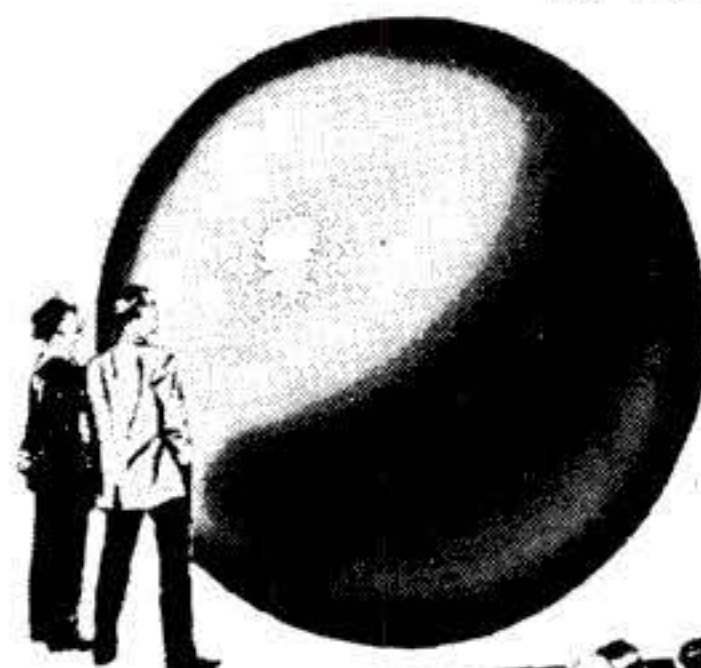


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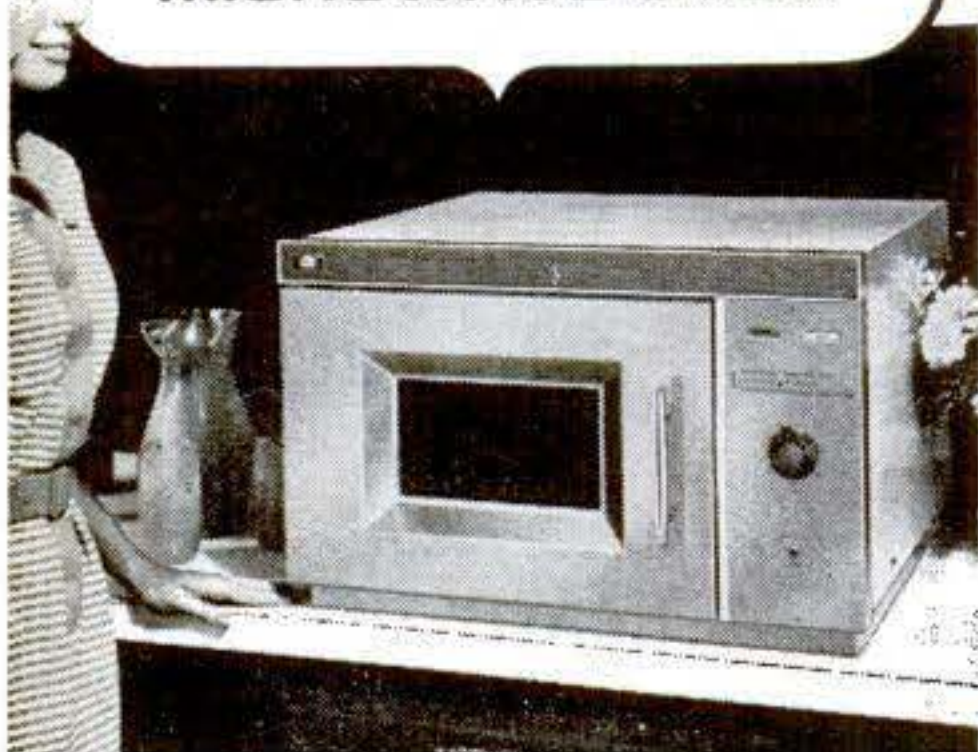
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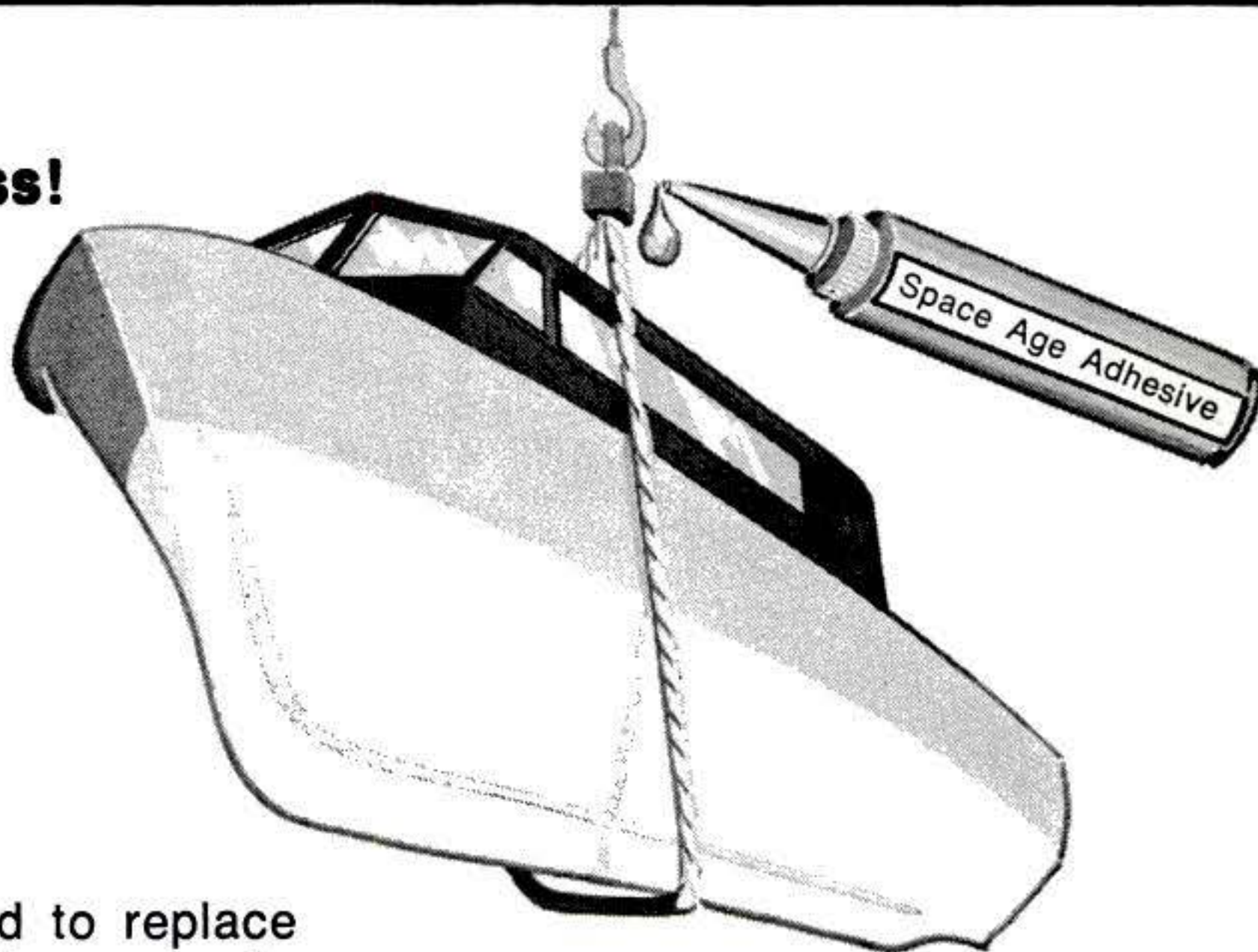
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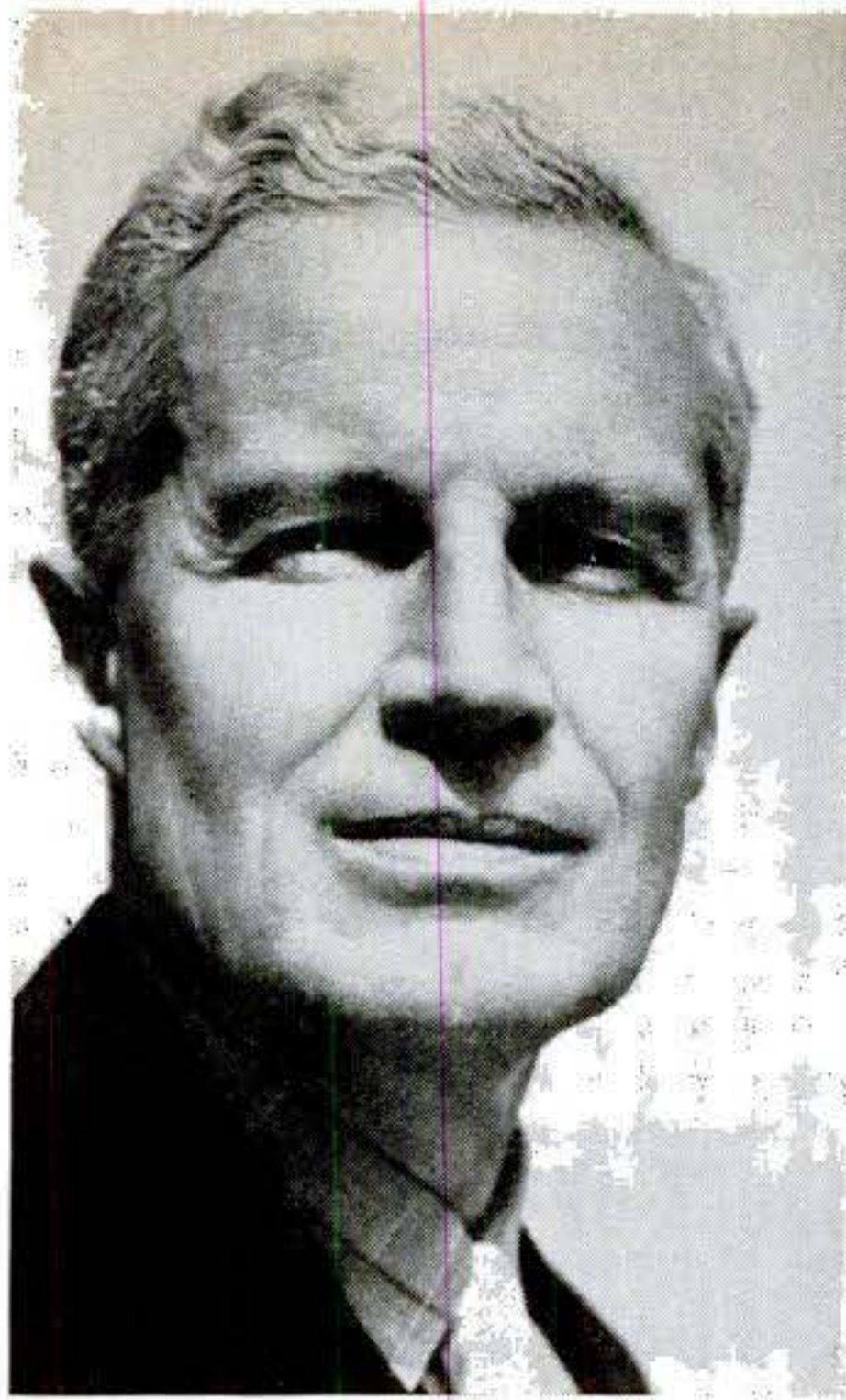
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summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish*! And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned*! I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

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While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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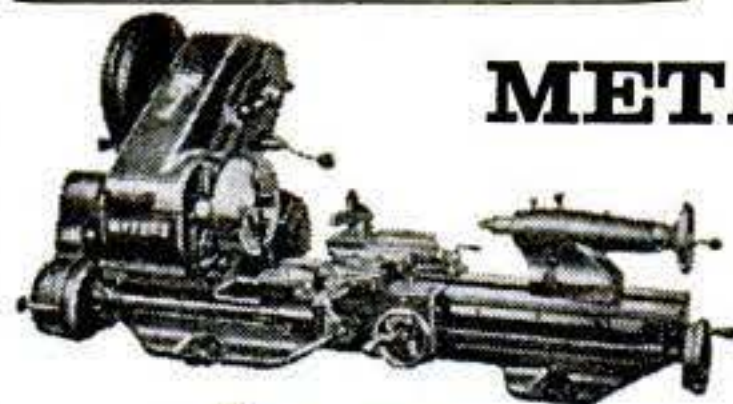
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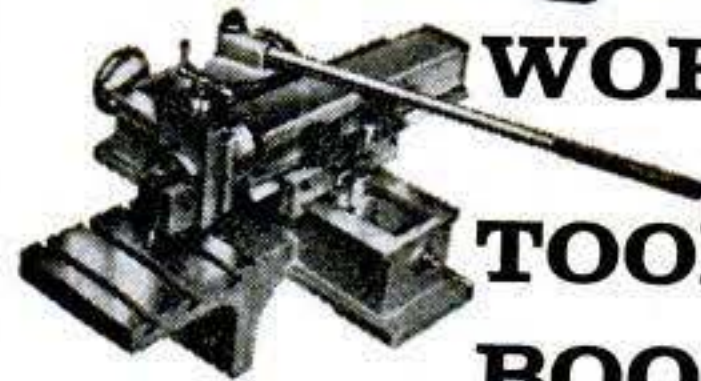
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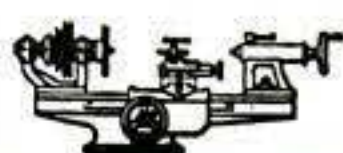
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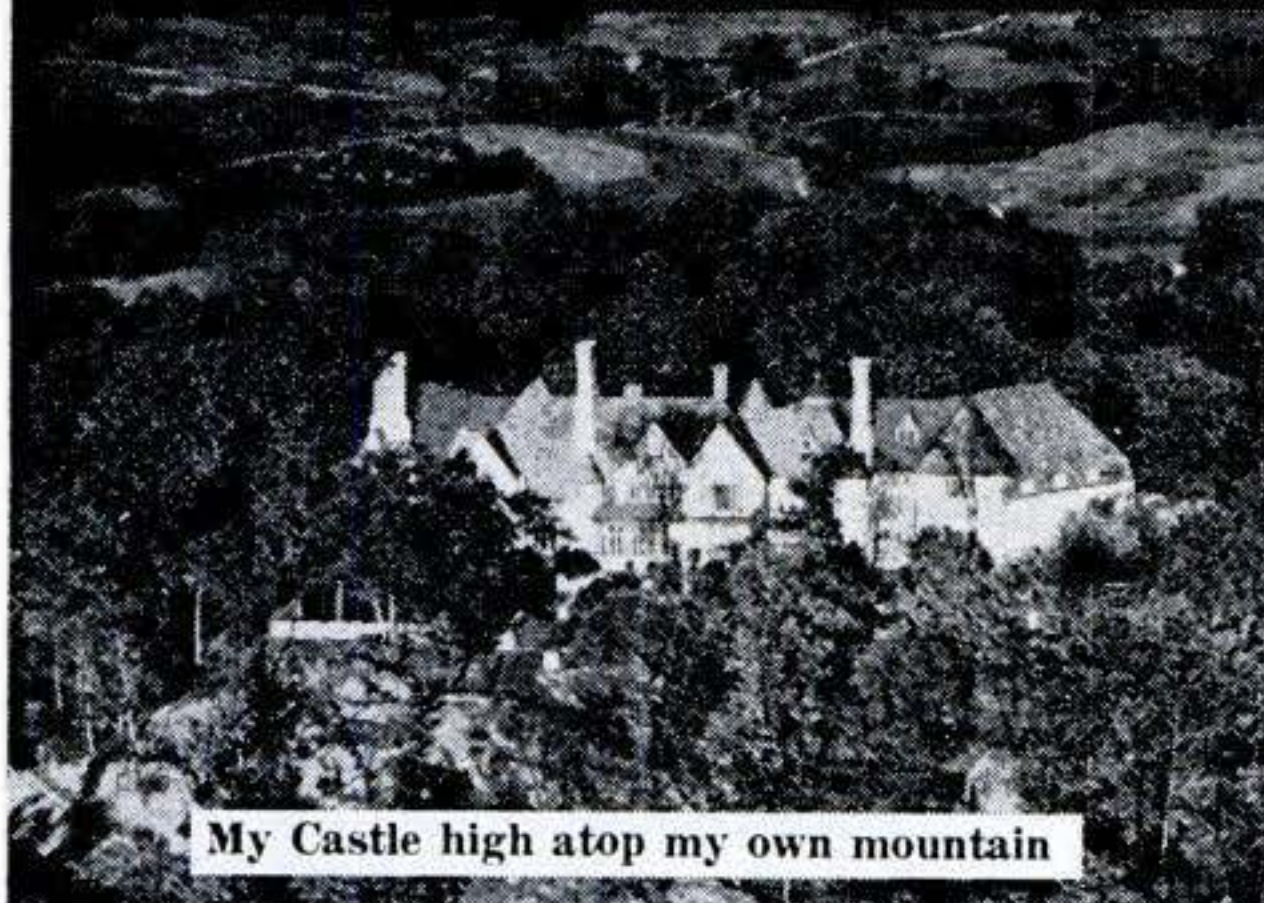
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**IF
YOU
WANT
TO BE
RICH!**



My dream came true by Copying Success

I WILL TEACH YOU MY SECRET OF COPYING SUCCESS!

THERE ARE 3 WAYS TO BECOME RICH. One is to be born rich. Two is to have wealth thrust upon you and Three is to achieve wealth. If you were not born rich, forget it, wishful thinking won't help. Some hope for a rich Uncle to remember them in a will. There is also the Lottery Ticket Type who reads travel folders while waiting for his number to be called. Waiting for wealth to fall on you is one of the most popular yet least successful ways of becoming rich. If this is your present system, forget it. **STOP DREAMING, WAKE UP, YOU MUST MAKE IT HAPPEN!**

YOU MUST COPY SUCCESS!

I have proven that a fortune can be made in a brief period if a person knows how. I can show you how to do it too. Why would I share my secret to success? Simply because it gives me a great feeling of satisfaction helping others to find their fortunes as I did. I will also probably make another fortune myself from these ads that are appearing all over this great country.

STOP USING EXCUSES NOW

Age, education, capital are unimportant in this system of making money. There are no degrees needed to be rich. I was going nowhere for years, then the opportunity to copy success came and I grabbed it, then my success story unfolded. I had problems too. I was born poor, quit school, washed dishes for 3 months and day dreamed how to make a better life. I got married and had children and worked selling everything from garbage cans to correspondence courses. I even worked on the side as a mechanic and painter. I worked 60 hrs. a week but ended up with so many debts and loans it seemed hopeless. We even took in boarders to make ends meet. I'm not talking about the depression years, I'm talking about just twelve years ago. I'm sure there are many going through the same thing, right now.

OPPORTUNITY UNFOLDED

right before me, just as this page is unfolded before you, not by plan but by chance. I was out selling and stopped into a man's office just at a moment when he was

counting what looked like thousands of dollars right there in front of my eyes. I just stood there in awe for a couple of minutes just looking at all that money. It wasn't bundled like from a bank, just loose bills crumbled on a desk in a pile about a foot high. The longer I stared the bigger that pile looked. I'll never forget that day because it was the beginning of the change I needed and wanted in my life. That man was making thousands of dollars a day and he had been doing it for years. He was a millionaire. I had to find out how he was doing it. I made up my mind to copy his secret or method or whatever it was that made him rich. I went to work for that man the next day. For 6 months I watched, listened and studied everything that man did. I learned the secrets this man developed in ten years of success. I put these methods to work on a limited basis at first because I had only limited money.

THEN IT STARTED WORKING FOR ME

I got out of debt and before I knew it I had made a fortune, more money than I imagined even in my day dreams.

Almost overnight people were calling me a genius. I was written about on the front page of the Wall St. Journal. People were coming to me for advice. I had a mansion in town. I owned buildings with rents coming in. I even bought a 55 room Castle atop my own mountain with swimming pool, tennis court and gardeners. I owned Lincolns and Cadillacs. My family and I traveled. We were suddenly financially successful and we did it by our secret of copying success.

I OFFER YOU OPPORTUNITY

even greater than my own. I offer to share with you my secrets for success that I have proven can work. Now I am going to ask you to send me Ten Dollars for sharing this way to wealth. The information I mail will cost me less than ten dollars and I hope to make profit (less the cost of this ad). I am sure you will not begrudge me making a profit, after all, it might make you rich. I would gladly have paid a thousand dollars 12 years ago for the key to success. You should never expect something for nothing, even the church passes the basket for directions to heaven. Never give away ideas, they may be worth millions. Start thinking right now about making money and stop worrying about losing ten dollars. Ten dollars won't even pay for a parking ticket in some cities. By the way, you can examine the information I send you for ten days and return it for a full refund if your not completely satisfied. All you risk is really an eight cent stamp.

NOT A BOOK OR FRANCHISE

I'm not offering you a stock scheme, merchandise or equipment. You won't have to leave your job knock on doors or get your friends to do it for you. No working in a cellar either. This is excellent for women too. It's possible to make more money at home than their husbands make at work.

I will not just tell you about my success story, but rather... I will introduce you to your own!

You can have cash coming in every day even when your sick or on vacation. Even holidays can't stop the cash flow of my system. Sound exciting? You bet it is. You will need lots of confidence in my system and very little money to get started. People with little capital

must have daring and be willing to take a chance if they want to make lots of money. If you have ten dollars worth of daring after reading this offer, I strongly urge you to put it in an envelope and I promise to show you how to change your life.

OTHERS GOT BACK THOUSANDS BECAUSE THEY BELIEVE IN ME AND MY SYSTEM NOT ONE LOST.

One man made \$30,000 in just six months using my secrets. I taught him what I will teach you and now he is independent. People from all walks of life have used my idea: A Teacher, janitor, lawyer, housewife, chemist, salesman, secretary and even a policeman. **NOT ONE EVER LOST A PENNY.** I cannot promise you will make as much money as I but then again you may make more.

OPPORTUNITY IS NOT JUST KNOCKING AT YOUR DOOR... IT'S ALMOST KNOCKING YOUR DOOR DOWN!!!

This is the chance you have been dreaming about... **NOW TAKE IT!** Your risk is only a stamp, your money is refunded if you find I'm wrong. **BUT.**

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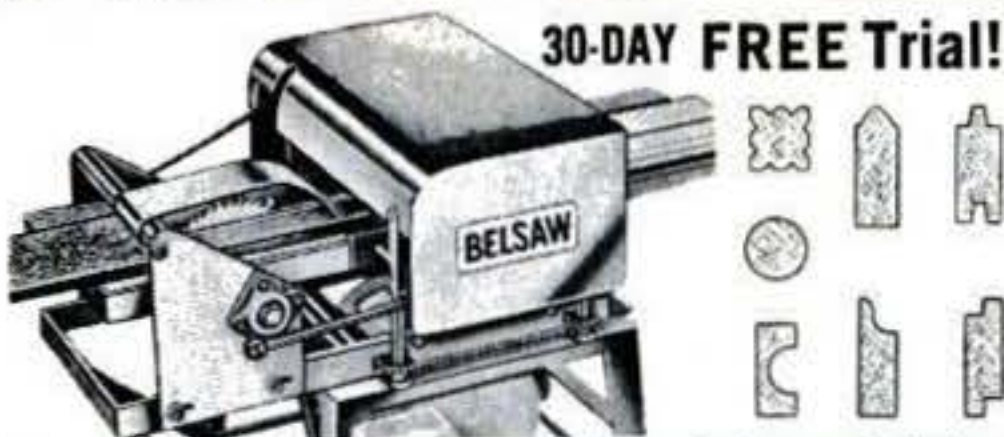
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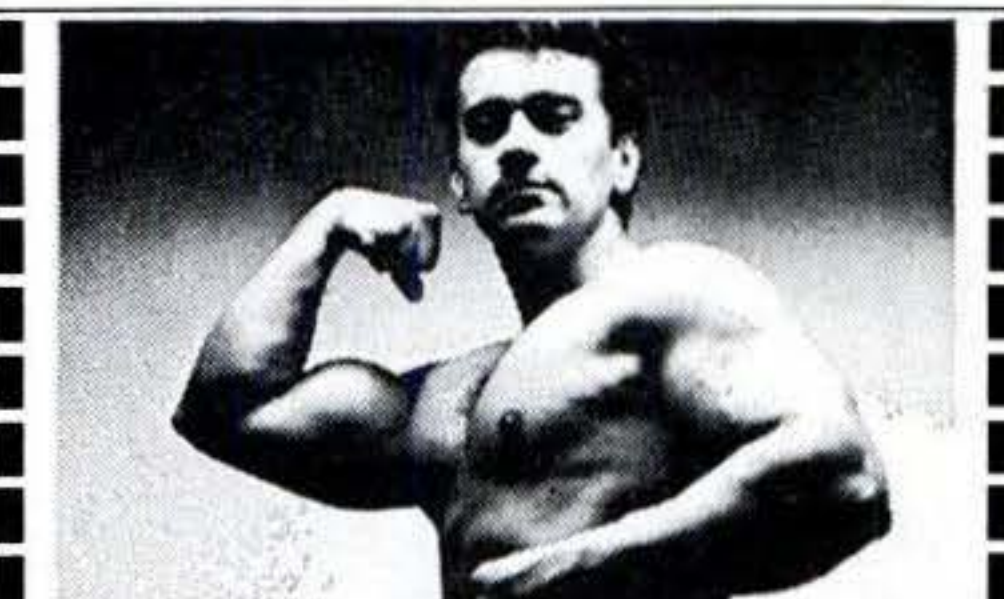
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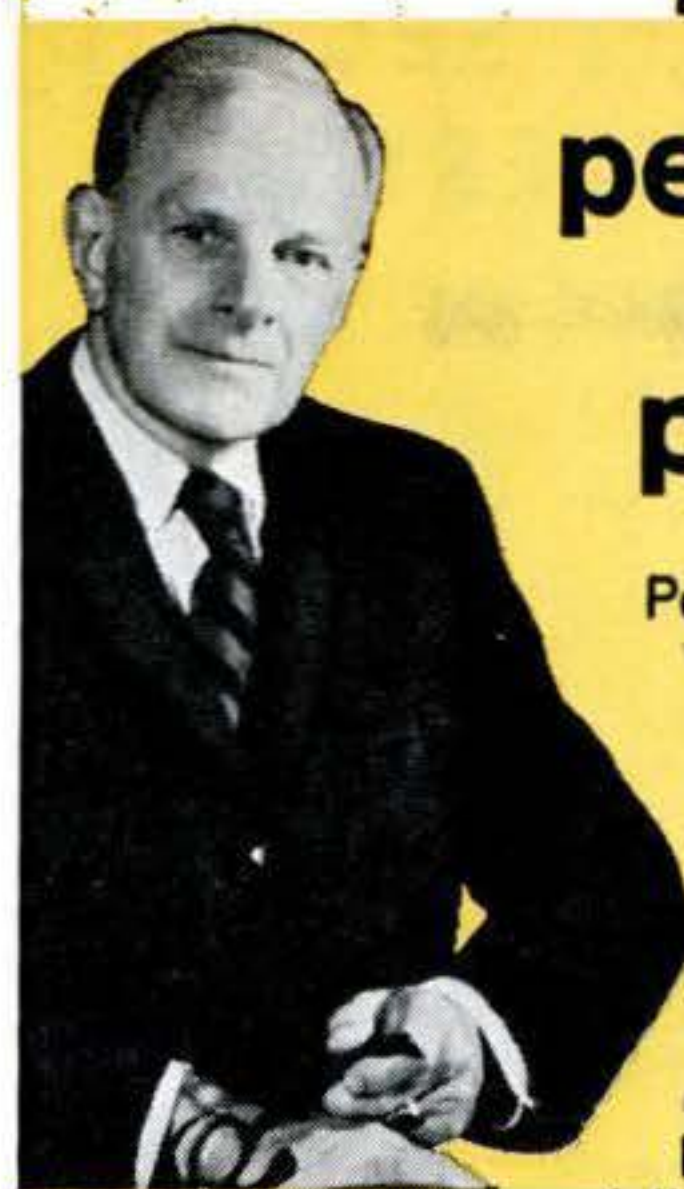
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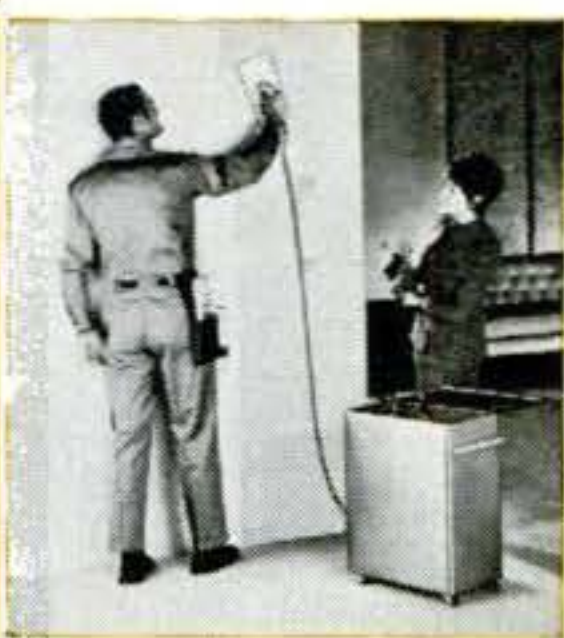
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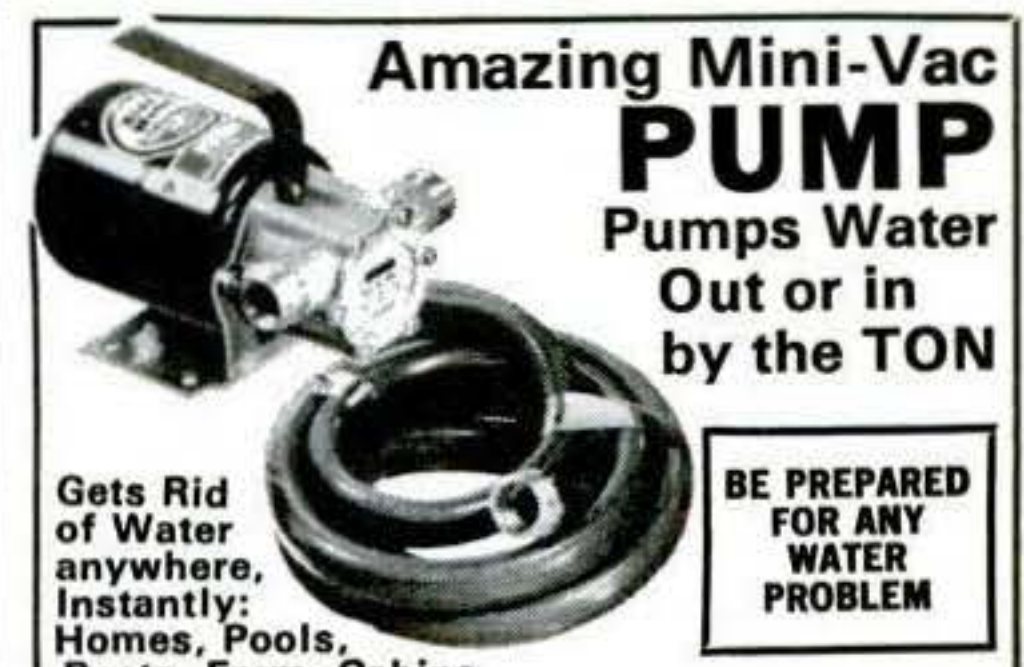
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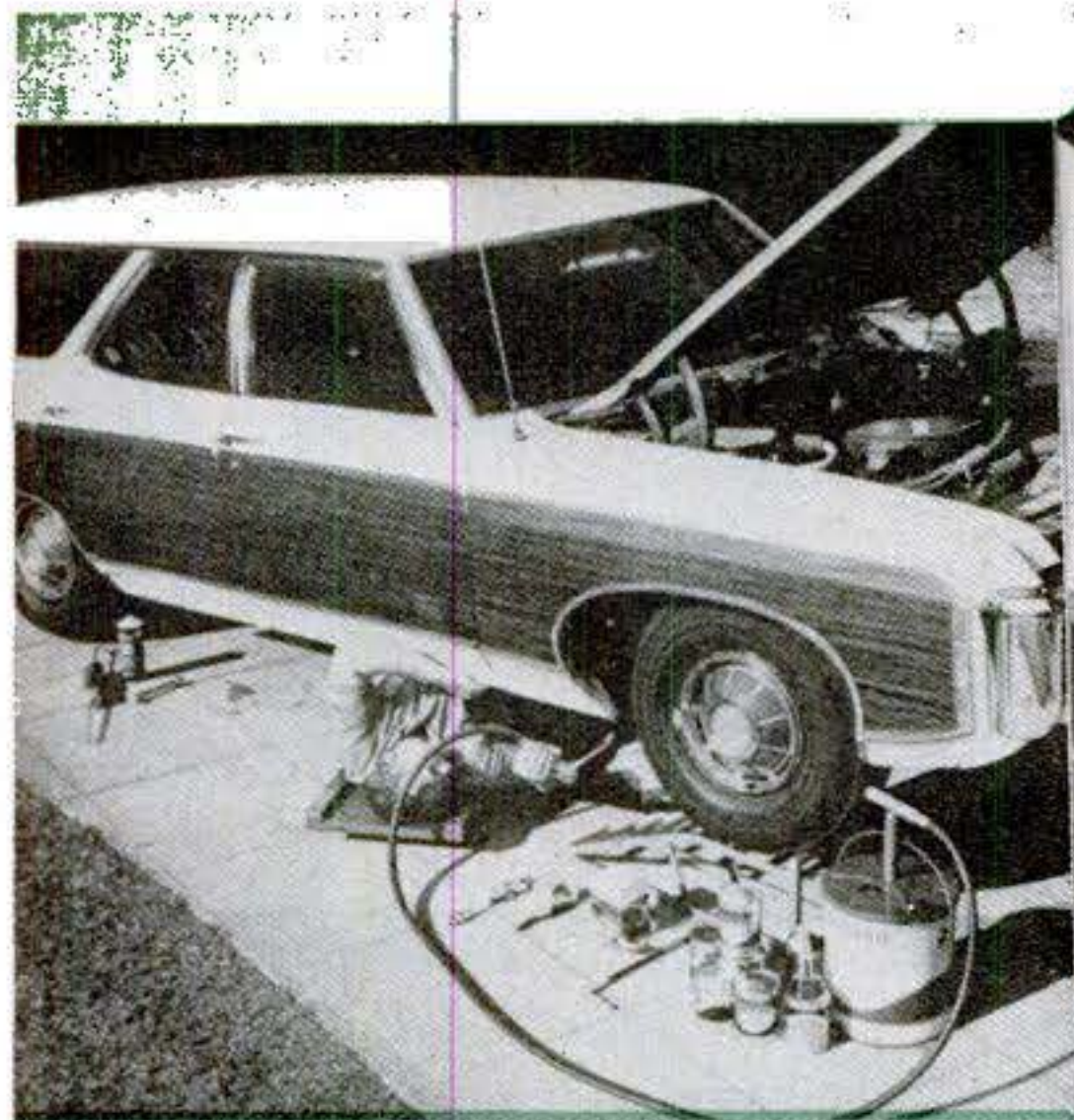
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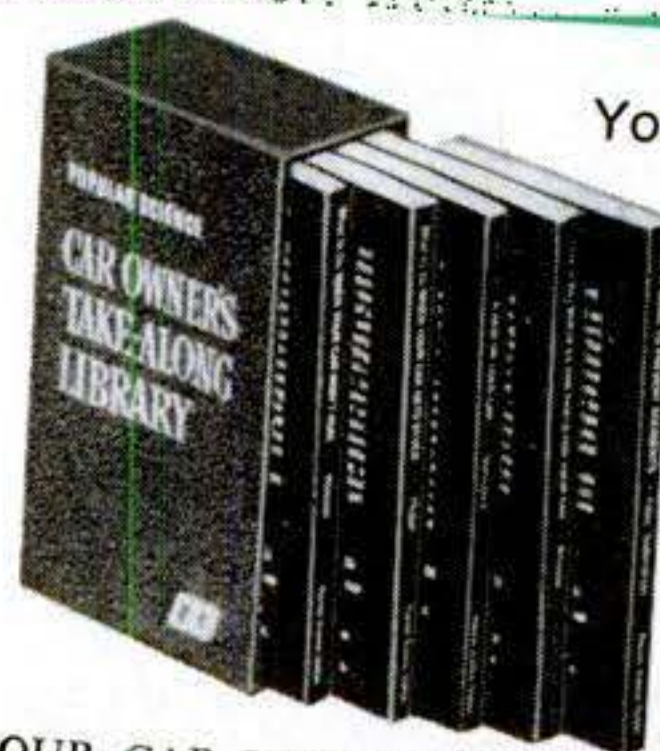
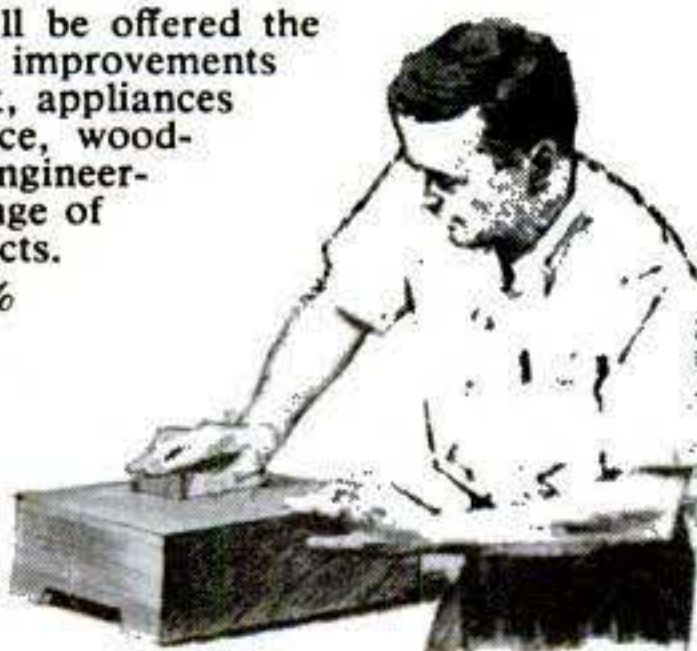
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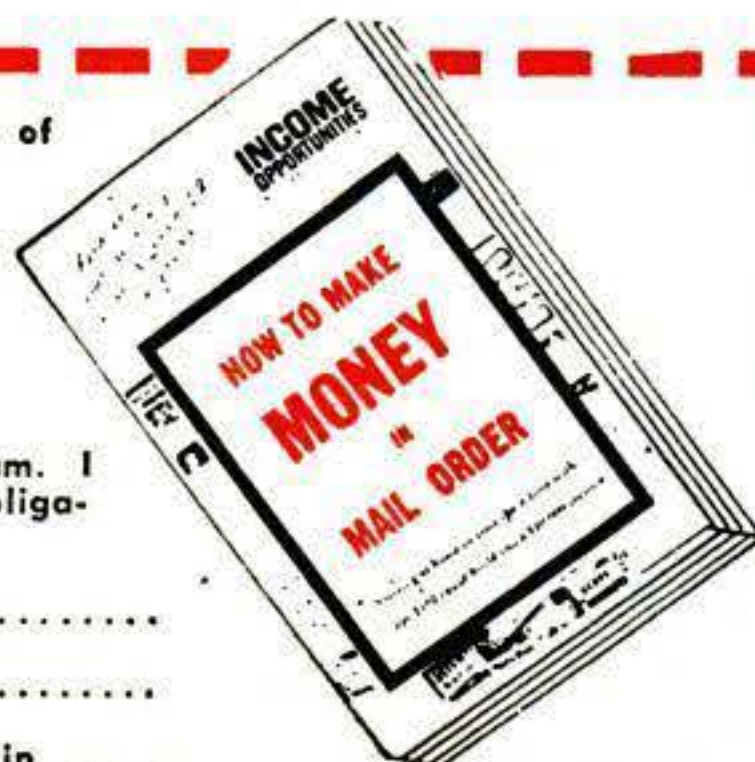
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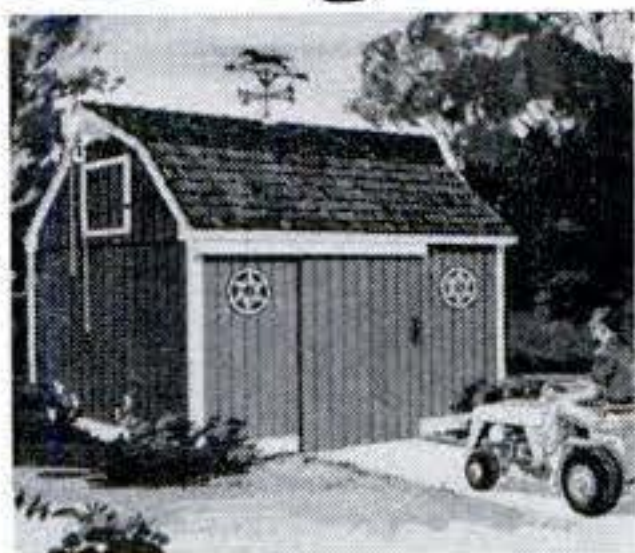
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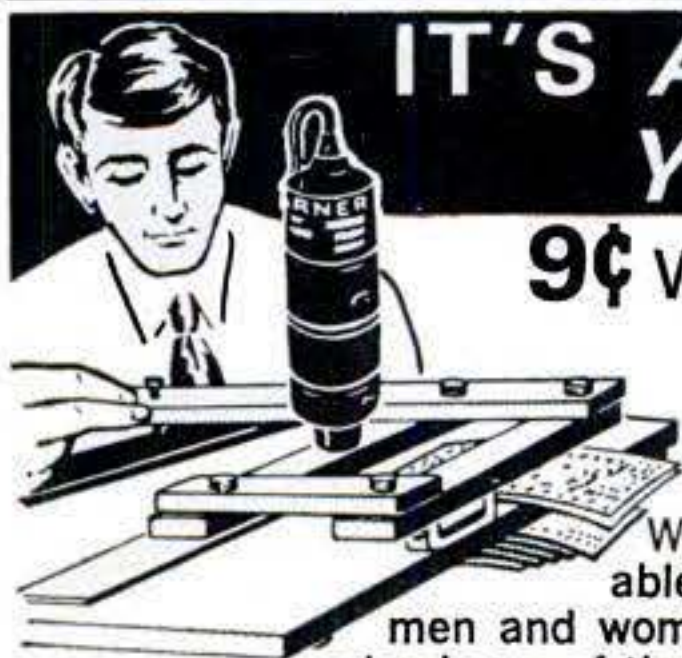
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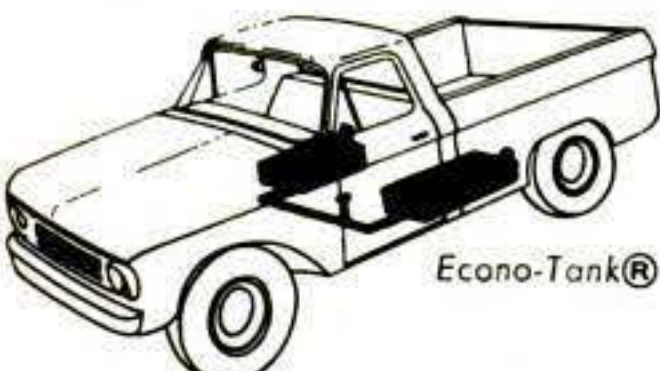
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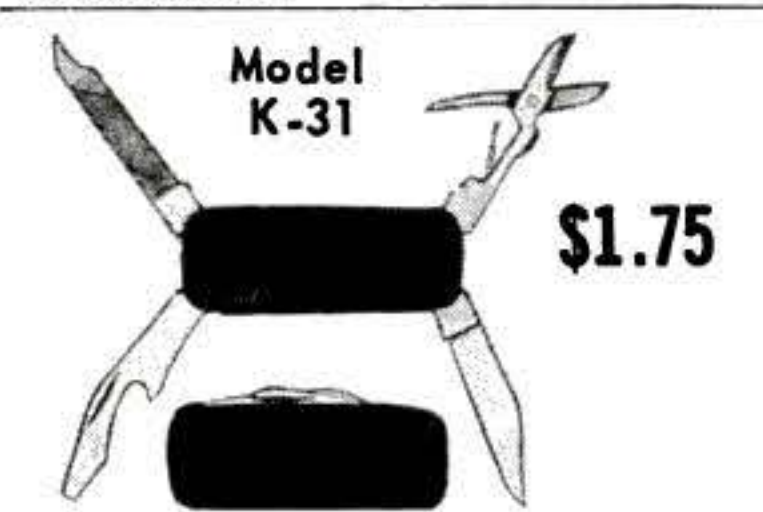
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105 MISCELLANEOUS

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WITHOUT OBLIGATION, please mail me a FREE FRANCHISE and DEALERSHIP to sell your HOME-KITS. I own a home which needs to be re-sided.

I am interested in a: ☐ Aluminum siding Do-it-yourself kits Send free sample ☐ Steel siding Do-it-yourself kits Send free sample ☐ Vinyl siding Do-it-yourself kits Send free sample
I would like to be considered for a: ☐ PART-TIME DEALERSHIP ☐ FULL-TIME DEALERSHIP
Address of Property I own which needs re-siding:

street town state zip
This property is located in what County? county state
My mailing address is: street town state zip

NOTICE

There is no charge for a HOME-KIT FRANCHISE. You must, however, apply a kit of either: Aluminum, steel, or vinyl siding to your own home for a display and in order to gain experience before selling the general public.

My age: My Present Occupation:
Print your name here as you would like it printed on your free franchise. first name middle name last name (print) (print) (print)

sign here please

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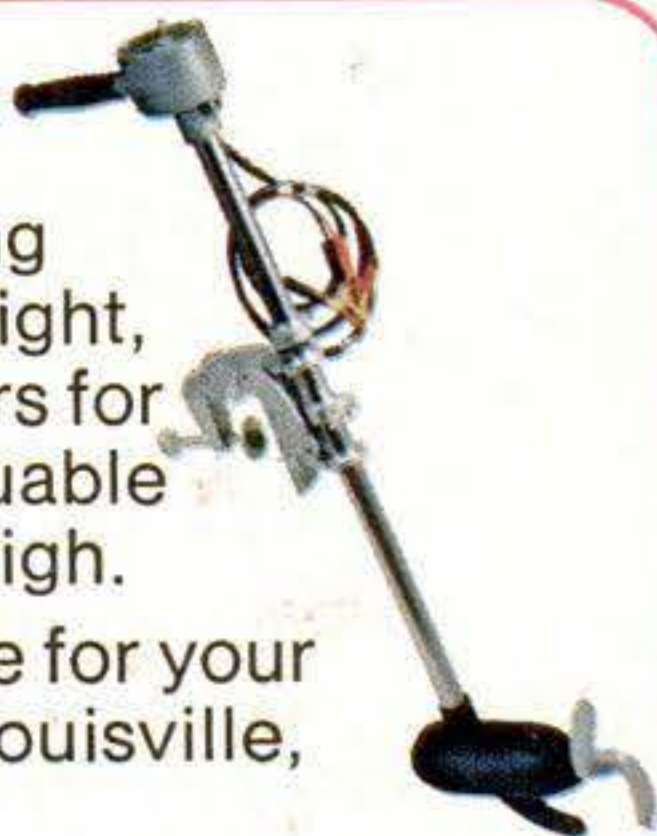


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